

Clinical Audit on the Use of Vasopressors and Inotropes in Pediatric Intensive Care Unit in Assiut University Children Hospital

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Abstract

Background: Shock is a state of circulatory dysfunction where the metabolic demands of the tissue cannot be met by the circulation. The early recognition of signs of shock and aggressive therapy to restore the intravascular volume and reverse the biochemical cascade is believed to improve outcome.

Patients and Methods: The study was done on children with shock admitted to intermediate care unit and PICU in Assiut University Children Hospital in one year duration. An observational checklist based on guidelines of management of shock according to Early Goal Directed Therapy (EGDT) developed by the investigators in order to assess the management plane and the use of vasopressors and inotropes in pediatric shock.

Results: In management at 0min.; Items of recognition of mental status, skin colour and determination of high flow O₂ each were recorded in 99.05%. Establishing IV/IO access was done in 100%. In management at 5min.; fluid therapy was given to 97.14% of patients, in 77.5% of them it was recorded. RBG was done for 96.19% of patients, recorded in 100% of them. Calcium level was assessed in 98.1% of patients, in 96.1% of them it was recorded. The percentage frequency of using inotropes in management of the studied patients at 15min as follow: Dopamine alone was used in 55.3% of cases, dobutamine alone was used in 44.7% of cases, adrenaline was used in 31.4% of cases in combination with other inotrope and noradrenaline was used in 14.2% of cases in combination with other inotrope. In management of shock at 60min. 35.24% of patients were given hydrocortisone.

Key Words: Paediatric – Shock – Early goal directed therapy – Inotropes – Monitoring – Intensive care unit.

Introduction

SHOCK is a physiologic state characterised by a significant, systemic reduction in tissue perfusion, resulting in decreased tissue oxygen delivery. Although the effects of inadequate tissue perfusion

are initially reversible, prolonged oxygen deprivation leads to generalised cellular hypoxia and derangement of critical biochemical processes. These abnormalities rapidly become irreversible and result sequentially in cell death, end-organ damage, failure of multiple organ systems, and death. The challenge for the clinician is to recognise children in shock early (before they develop hypotension), when they are more likely to respond favourably to treatment. A strong index of suspicion, early recognition, timely intervention and transfer to an intensive care unit are critical for successful outcomes in the management of paediatric shock [1].

Although the cause of shock may not be initially apparent, treatment must begin immediately. To assist with this early recognition, a systematic approach to the evaluation of children with evidence of poor perfusion typically identifies features of the history, physical examination, and ancillary studies that suggest the underlying condition. The paediatric assessment triangle (PAT) provides this systematic approach and rapidly provides a quick evaluation of appearance, breathing, and circulation for acutely ill or injured children that should identify conditions that require immediate intervention. To direct rapid and appropriate treatment, early goal directed therapy was developed to provide an efficient and effective means of immediate intervention. Early Goal Directed Therapy (EGDT) for shock refers to an aggressive systematic approach to resuscitation involving a series of controlled manipulations of physiologic parameters. The goal is to carry out appropriate treatment according to the algorithm within the first hour of presentation to hospital [2,3].

The aim of this study is:

To evaluate the physicians compliance to the guidelines for the use of vasopressors and inotropes

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in pediatric shock at PICU of Assuit University Children Hospital compared to the recent guidelines [4] and what should be done for improvement of the system. The outcome of this study will be the subject for another audit to re-evaluate the application of the recommendation to improve physician performance and patient outcome.

Patients and Methods

The study was done on children with shock admitted to intermediate care unit and PICU in Assiut University Children Hospital in one year duration in the period between April 2016 and April 2017. The study included 105 cases aged from 1 year to 18 years, 66 males and 39 females.

Inclusion criteria:

All patients admitted to PICU and vasopressors and inotropes were used in their management.

Exclusion criteria:

Any patients in PICU for whom vasopressors and inotropes were not indicated to be used.

Tools of study:

An observational checklist based on guidelines of management of shock according to Early Goal Directed Therapy (EGDT) was developed by the investigators in order to assess the management plane and the use of vasopressors and inotropes in pediatric shock [4].

The parameters to be assessed were included:

History: Traumatic injury-Bleeding-Vomiting and diarrhea-Infection and fever-Heart disease-Inadequate immune system-Allergic exposure.

Examination: General: Heart Rate-Blood Pressure-Prolonged Capillary refill-Conscious level-Respiratory distress. Specific:Hypovolemic shock: Sunken eyes and fontanells-Oliguria-Cardiogenic shock:Bradycardia-Irregular pulse-Gallop rhythm-Hepatomegaly-crepitations-Jugular veins dilatation. Anaphylactic: Angioedema-respiratory distress (score)-Stridor-Wheezing-Early hypotension. Neurogenic: Hypotension in the absence of tachycardia. Septic: Warm: Bounding pulses-Warm extremities with hypotension-Hyperpnoea. Cold: Poor peripheral pulsations-Hyperpnoea-Cold extremities. Obstructive: Hypotension-Jugular veins dilatation-Tracheal deviation.

Management: At 0min: Recognize mental status-Recognize perfusion (capillary refill time-skin colour)-Begin high flow O2-Establish IV/IO access.

At 5min: Initial resuscitation (20cc/kg saline Or colloid up to and over 60 cc)- Correct hypoglycemia and hypocalcemia. At 15 min: What inotrope used- Is it the right choice- Is it in the right dose Is there is monitoring of: Urine output (presence of Catheter-record of output and input) Capillary refill time-Blood pressure-Pulse-Respiration-Conscious level. At 60min: Use hydrocortisone.

Result: Is there is improvement.

Results

The study was done on children with shock admitted to intermediate care unit and PICU in Assiut University Children Hospital in one year duration in the period between April 2016 and April 2017. The study included 105 cases.

Table (1): Demographic data of studied patients.

	No.	%
<i>Age:</i>		
<1 year	72	68.6
1-5 years	22	21.0
6-12 years	9	8.6
13-18 years	2	1.9
<i>Sex:</i>		
Male	66	62.9
Female	39	37.1

Table (2): History performance for the studied patients with shock.

	Done		Recorded		Not done	
	No.	%	No.	%	No.	%
Infection and fever	95	90.48	89	93.68	10	9.52
Vomiting and diarrhea	91	86.67	85	93.41	14	13.33
Bleeding	90	85.71	85	94.44	15	14.29
Inadequate immune system	24	22.86	19	79.17	81	77.14
Heart disease	18	17.14	17	94.4	87	82.86
Traumatic injury	16	15.24	11	68.75	89	84.76
Allergic exposure	5	4.76	4	80.00	100	95.24

Table (3): General clinical manifestations for the studied patients with shock.

	Done		Recorded		Not done	
	No.	%	No.	%	No.	%
Heart rate	104	99.05	101	97.1	1	0.95
Blood pressure	104	99.05	102	98.1	1	0.95
Capillary refill time	103	98.1	35	36.75	2	1.9
Conscious level	102	97.14	99	97.1	3	2.86
Respiratory distress	95	90.48	95	90.48	10	9.52

Table (4): Numbers and percentages of what is done in cases of shock at 0min and what recorded from them.

	Done		Recorded		Not done	
	No.	%	No.	%	No.	%
Recognize mental status	104	99.05	103	99	1	0.95
Skin color	104	99.05	102	98.1	1	0.95
High flow O2	104	99.05	104	100	1	0.95
Establish IV/IO access	105	100	9	9	0	0.00

Table (5): Percentage frequency of using inotropes in management of the studied patients at 15min.

	Results	
	No.	%
<i>Inotrope:</i>		
Dopamine	58	55.3
Dobutamine	47	44.7
Combined with adrenaline	33	31.4
Combined with noradrenaline	15	14.2

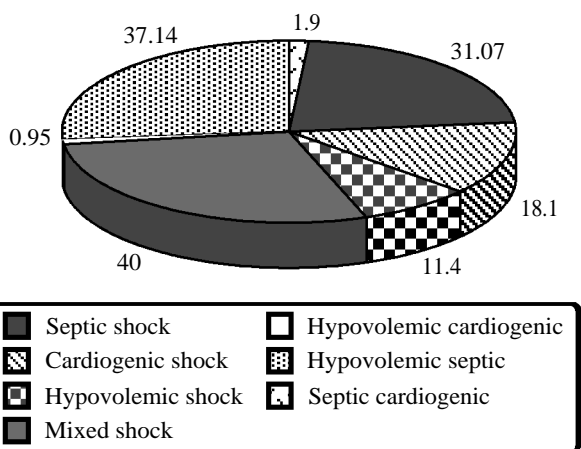


Fig. (1): Percentage frequency of types of shock among the studied cases.

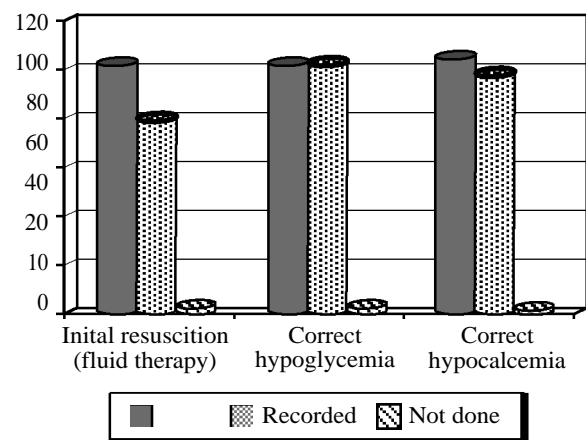


Fig. (2): Numbers and percentages of what is done in cases of shock at 5min and what recorded from them.

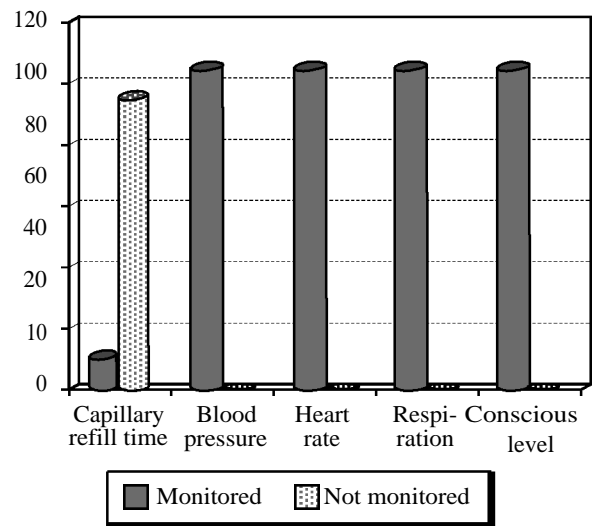


Fig. (3): Percentage frequency of monitoring of clinical follow-up items in management of shock among the studied cases.

Discussion

Shock is a state of circulatory dysfunction where the metabolic demands of the tissue cannot be met by the circulation. Millions of children die of shock due to various etiologies each year. Several different etiologies from hypovolemia to severe infection can result in shock.

Early recognition and timely intervention are critical in treating shock and preventing progression of the shock cascade. Furthermore, early goal directed therapy has been shown to decrease mortality in adults and children [5]. In infants and children a 9 fold improvement in survival rate was achieved when aggressive resuscitation was initiated early by the emergency room physician [6].

So we did comparison between guidelines of management of shock according to Early Goal Directed Therapy (EGDT) and what we do in pediatric intermediate and ICU units of Assiut University Pediatric Hospital [4].

Fisher [7] reported that the incidence of type of shock in pediatric patients who present to the emergency department, sepsis is the highest leading cause (57%), followed by hypovolemic shock (24%), distributive shock (14%), and cardiogenic shock (5%). While in the present study the majority of patients had mixed shock (40%) then septic shock (31.07%), cardiogenic shock (18.1%) and hypovolemic shock (11.4%).

Concerning recording, no recorded informations in the patient's files about type of shock was detected in all studied cases.

As regards general clinical manifestations of the studied patients with shock, according to EGDT assessing heart rate, blood pressure, capillary refill time, conscious level and detection of respiratory distress were essential for all patients suspecting to have shock [8].

While in the present study, assessing heart rate and blood pressure both were done in 104 cases (in 99.05% of cases), capillary refill time in 103 cases (in 98.1% of cases), conscious level in 102 cases (in 97.14% of cases) and respiratory distress in 95 cases (in 90.48% of cases).

Concerning recording, heart rate was recorded in 101 cases (in 97.1% of assessed cases), blood pressure in 102 cases (in 98.1% of assessed cases), capillary refill time in 35 cases (in 36.75% of assessed cases), conscious level in 99 cases (in 97.1% of assessed cases) and respiratory distress in 95 cases (in 90.48% of assessed cases).

As regards management of shock at 0 min.:

According to EGDT, Providing oxygen, stabilization of the airway, and establishment of vascular access are immediate goals, followed rapidly by fluid resuscitation. Supplemental oxygen should be administered to all patients with oxygenation measured by pulse oximetry. Intubation may be required for airway stabilization when mental status changes occur to prevent imminent respiratory failure or to decrease the work of breathing and oxygen consumption [3].

Comparing with the guidelines, in the present study items of recognition of mental status, skin color, determination of high flow O₂ and establishing IV/IO access each were done in 104 cases (in 99.05% of cases). While recording data was good (98.1 %-100%) but it was highly defective in recording establishing IV\IO access (9 cases only 8.7%).

Concerning management at 5min.:

According to EGDT, Initial fluid resuscitation should be started with isotonic crystalloid infusions. A 20mL/kg infusion over 5 minutes should be given to hypotensive children without signs of cardiogenic or obstructive shock. Patients with compensated shock should still receive the same rapid infusion over 5-20 minutes as long as there are no signs of cardiogenic or obstructive shock, diabetic ketoacidosis (DKA) or other conditions that may worsen with fluid administration [3]. In the case of cardiogenic shock, fluid must be administered cautiously and at a lower volume (510ml /kg over 10-20 minutes) [3].

In the present study fluid therapy was given to 102 cases (in 97.14% of patients) and recorded in 79 cases (in 77.5%) of them. The amount of fluid was given according to the items of guidelines in 63 cases (in 60% of patients) but applied not completely in 42 cases (in 40% of patients).

Also at 5min according to guidelines, RBG and Ca levels should be checked to all patients [9]. While in the present study RBG was done for 101 cases (in 96.1 % of patients) and recorded in 100% of them, but Ca level was assessed in 103 cases (in 98.1% of patients) and recorded in 96.1% of them.

Concerning management of shock at 15min:

According to EGDT, testing for signs of fluid overload (decreased oxygenations, rales, gallop rhythm, tachypnea, wet cough and hepatomegaly) must be done before and after each bolus [8]. Presence of these signs is usually an indication to stop fluid resuscitation and initiate inotrope therapy.

Vasoactive drug therapy is suggested for children with cardiogenic or septic shock who have not responded to isotonic fluid resuscitation (up to 60ml/kg or more).

If cold shock has been identified, this can be treated with central dopamine or if resistant, central epinephrine. Warm shock should be reversed with norepinephrine [3].

In the present study, dopamine alone was used in 58 cases (in 55.3% of cases), dobutamine alone was used in 47 cases (in 44.7% of cases), adrenaline was used in 33 cases (in 31.4% of cases) in combination with other inotrope and noradrenaline was used in 15 cases (in 14.2% of cases) in combination with other inotrope.

The choice of type and dose of inotropes used were applied completely according to items of guidelines in 67.6%, but applied not completely in 32.4% of patients.

False choice was in 32.4% of patients. This was due to either start giving an inotrope other than dopamine (in the indicated type of shock), or due to addition of drugs not respecting items of guidelines.

As regards monitoring and evaluation:

According to EGDT, frequent monitoring of physiologic parameters and the appropriate adjustments of therapeutic adjustments are the core of the management. This therefore requires continuous

hemodynamic monitoring and end organ perfusion assessment (brain, kidneys, skin) [10].

During the initial stage of shock, many parameters can be monitored non invasively and if the child responds well, invasive monitoring can often be avoided [11]. Continuous measurement of heart rate and pulse oximetry is necessary with frequent blood pressure measurements. In addition to these parameters, the following should be assessed before and after each fluid bolus:

- Quality of central and peripheral pulses.
- Skin perfusion (indicated by temperature and capillary refill).
- Mental status.
- Auscultation of lung and heart sounds.
- Palpation of liver edge (to identify hepatomegaly as a sign of heart failure).
- A urinary catheter should be placed to monitor urine output.

The quality of central and peripheral pulses, skin perfusion, mental status and urine output have all been shown to be appropriate signs of the response to therapy [10].

While in the present study:

- Assessment of urine output was done in 101 cases (in 96.1% of patients) and recorded in 81 cases (in 80.2% of them). While not assessed only in 4 cases (in 3.81% of patients). Catheters were inserted in 62.86% of patients. Fluid input and urine output were monitored in 81 cases (in 77.2% of patients).
- Assessment of capillary refill time was done in 103 cases (in 98.1% of patients) but recorded only in 9 cases (in 8.7% of them).
- Blood pressure measurement was done in 104 cases (in 99.05% of patients) and recorded in 97 cases (in 93.3% of them).
- Heart rate assessment was done in 104 cases (in 99.05% of patients) and recorded in 98 cases (in 94.2% of them).
- Respiration assessment was done in 103 cases (in 98.1% of patients) and recorded in 99 cases (in 96.1% of them).
- Conscious level assessment was done in 104 cases (in 99.05% of patients) and recorded in 96 cases (in 92.3% of them).

About monitoring:

- Items of blood pressure, heart rate, respiration and conscious level each were monitored in 104

cases (with a percentage of 99.05% of cases). Capillary refill time monitored only in 10 cases (with a percentage of 9.53% of patients).

About improving:

- Capillary refill was improving in 77 cases (in 73.33% of cases).
- Items of blood pressure, heart rate, respiration and conscious level each were improving in 80 cases (in 76.19% of cases).

Concerning management of shock at 60min. and use of hydrocortisone:

According to EGDT, any shock resistant to epinephrine or norepinephrine should raise suspicions of adrenal insufficiency and a cortisol level under 18mg/dL can aid in the diagnosis [2]. In this situation, hydrocortisone succinate therapy should be initiated at a dose of 50mg/kg followed by the same dose over 24 hours [12]. Hydrocortisone is preferred to methylprednisone or dexamethasone as it has both glucocorticoid and mineralocorticoid effects [8].

In the present study 37 cases (with a percentage of 35.34% of patients) were given hydrocortisone and 24 cases (with a percentage of 22.86%) of them were recorded.

Improvement of the condition and reversal of the shock occurred in 59 cases (with a percentage 56.2% of patients) but death occurred in 46 cases (with a percentage 43.8% of patients).

Conclusion:

We need to stick with the international guidelines as a reference standard to avoid missing important investigations or use of unnecessary investigations or lines of management unless recommended to improve the health services provided in emergency unit.

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دراسة تدقيقية فى استخدام قابضات الأوعية ومقومات التقلص العضلى فى وحدة العناية المركزة للأطفال فى مستشفى جامعة أسيوط

تعرف الصدمة بأنها حالة قصور حاد فى الطاقة بسبب الوارد غير كافي من الجلوكوز والأكسجين أو فشل الميتاكوندريا على المستوى الخلوى. الصدمة هى السبب الرئيسى للوفاة عند الأطفال عالمياً. حيث يموت أكثر من ١٠ مليون طفل كل عام بسببها. وتلاحظ أعلى عدد الوفيات عند الأطفال تحت عمر الخامسة فى البلدان النامية.

تنتج الصدمة عن أسباب متعددة ومن أسبابها الرئيسية عند الأطفال: الالتهاب الرئوى (١٩٪) والسعال (١٨٪) والملاريا (٨٪) والالتهاب الرئوى الوليدى أو الأنتان (١٠٪) والولادة المبكرة (١٠٪) والأختناق أثناء الولادة (٨٪).

نشخص الحالة السريرية للصدمة بالاعتماد على العلامات الحيوية والفحص الجسمى والبيانات المخبرية على الرغم من صعوبة التعرف عليها عند الأطفال.

يؤدى التأخر فى التعرف على حالة الصدمة ومعالجتها الى حدوث الأيض اللاهوائى والحماض النسيجى وتفاقم ضرر الأعضاء والخلايا من الحالة القابلة للعكس المعارضة الى الحالة متعذرة العكس. قد تكون المراضة الناتجة عن حالة الصدمة واسعة الانتشار ومن بينها فشل الجهاز العصبى المركزى و الفشل التنفسى (مثل ، الفشل الناتج عن تعب العضلات أو متلازمة الضائقة التنفسية الحادة) والفشل الكلوى وسوء الوظيفة الكبدية والإقفار الهضمى والتخثر المنتثر داخل الأوعية و الأختلال الأيضى وأخيراً الموت.

يمكن تقسيم حالة الصدمة عند الأطفال إلى طورين رئيسيين:

١- السبيل الهوائى والتنفس والدوران (ABCs): يجب إعطاء السوائل والأدوية المقلصة للعضلات خلال الساعة الأولى من الإنعاش وضبطها للمحافظة على أهداف المعدل القلبي والضغط الدموى وفقاً للعمر وإمتلاء شعرى دموى طبيعى أقل أو يساوى ٢ ثانية. ويجب دعم الأكسجة والتهوية بشكل مناسب.

٢- المثبات: بعد الساعة الأولى يجب أن يتحول التدبير إلى غرفة العناية المشددة لتقديم دعم ديناميكى دموى والحفظ على الأهداف العلاجية. تتضمن أهداف المعالجة ضغط إروائى طبيعى تبعاً للعمر، الإشباع الأكسجيني الوريدى المركزى < ٧٠٪، المنسب القلبي (نسبة نتاج البطين الأيسر فى الدقيقة إلى مساحة سطح الجسم) من ٣.٣ إلى ٦ لىتر/دقيقة.

وقد تمت هذه الدراسة على الأطفال المصابين بالصدمة المحجوزين بوحدتى العناية المتوسطة والمركزة فى مستشفى الأطفال بجامعة أسيوط خلال سنة من شهر أبريل ٢٠١٦ إلى شهر أبريل عام ٢٠١٧.

وأشتملت الدراسة على ١٠٥ مريض من عمر سنة حتى عمر ثمانى عشر سنة ٦٦ ذكور و ٣٩ إناث .

هدف الرسالة: تقييم أداء الأطباء تبعاً للمبادئ التوجيهية في استخدام قابضات الأوعية ومقومات التقلص العضلي في وحدة العناية المتوسطة والمركزة للأطفال في مستشفى الأطفال بجامعة أسيوط مقارنة بالمبادئ التوجيهية الحديثة وما ينبغي القيام به لتحسين هذه الدراسة تكون موضوع لدراسة تدقيقية أخرى لإعادة تقييم التزام الأطباء بالتوصيات من أجل تحسين أداء الأطباء والحالة الصحية للمرضى.

معايير الأدرج: كل المرضى الذي تم إعطائهم قابضات الأوعية ومقويات التقلص العضلي المحجوزين بالعناية المتوسطة والمركزة للأطفال في مستشفى جامعة أسيوط.

معايير الاستبعاد: كل المرضى بالعناية المتوسطة والمركزة للأطفال في مستشفى جامعة أسيوط الذين لم يلزم لهم استخدام قابضات الأوعية ومقويات التقلص العضلي.

وقد إسفرت نتائج هذه الدراسة على التوصيات الآتية:

- ينبغي أخذ التاريخ المرضى بالكامل وخصوصاً تاريخ الصدمة والتعرض للحساسية والعدوى المتكررة وأمراض القلب.
- فحص دقيق للمريض وخصوصاً التعبئة الدموية والعلامات الخاصة بكل نوع من أنواع الصدمة.
- تحسين توفير المستلزمات مثل قياس نسبة الأكسجين عن طريق النبض وتوفير أحجام مختلفة للكفات مناسبة لقياس ضغط الدم لمختلف الأعمار.
- تحديد نوع الصدمة أمر هام جداً.
- يجب القيام بتسجيل بيانات المرضى بطريقة صحيحة لتسهيل متابعة الحالة الصحية للمرضى ومن أجل توفير سجلات وأحصائيات دقيقة.
- يجب إعطاء السوائل اللازمة في الوقت المناسب والكمية المطلوبة.
- تحديد نسبة الجلوكوز وغازات الدم والكالسيوم من الأمور الهامة.
- ينصح بالإختيار الصحيح لقابضات الأوعية ومقويات التقلص العضلي حسب نوع الصدمة والحالة الصحية للمريض.
- متابعة مستمرة لحالة المريض المصاب بالصدمة وخصوصاً كمية البول والتعبئة الدموية الشعيرية. إذا كانت نسبة الهيموجلوبين أقل من ١٠ جرام ينبغي أن يعطى نقل دم للمريض لتحسين وصول الأكسجين للأنسجة.