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(CASE REPORT)

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Case Report: A 52-year-old female with Bacterial Infection and Drug Allergy

Ichsanto Permadi [1,*], Adeh Mahardika [2] and Misriyani [3]

[1] *Department of Physiology, Medical Faculty Alkhairaat University, Palu, Central Sulawesi, Indonesia.*
[2] *Department of Internal Medicine, Medical Faculty Alkhairaat University, Palu, Central Sulawesi, Indonesia.*
[3] *Department of Biochemistry, Medical Faculty Alkhairaat University, Palu, Central Sulawesi, Indonesia.*

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Abstract

This bacterial infection has a major impact on public health. There are many bacteria that are able to adapt to survive in water, soil, food, and various other places. The development of bacterial infection to cause disease is influenced by several factors including the infectivity of the organism, the pathogenicity of infectious organisms, the ability of pathogenic bacteria to avoid the body's immunity, virulence factors of pathogenic bacteria, and the role of human immunity cells themselves. In the treatment of patients with bacterial infections there are some real challenges in the use of drugs because it can occur allergic conditions to drugs ranging from antibiotics to other supportive therapies. So in this article, we will review the case of a patient who has a bacterial infection accompanied by a adverse drug reactions condition**,** In this article review, patients 52-year-old female experience bacterial infections accompanied by adverse drug reactions conditions, such as anxiety, chest heaviness accompanied by shortness of breath immediately after drug administration.

Keywords: Bacterial Infection; Adverse Drug Reactions; Drug Hypersensitivity Reactions; Drug Allergy; Antibiotic Allergy

1. Introduction

Bacteria are found in various places and play an important role in maintaining the environment in which we live. Only a small percentage of bacteria in the world cause infections and diseases. This bacterial infection has a major impact on public health. There are many bacteria that are able to adapt to survive in water, soil, food, and various other places [1].

The development of a bacterial infection to cause a disease is influenced by several factors. First, the infectivity of an organism determines the number of individuals that will be infected compared to the number of susceptible and exposed. Pathogenicity is the potential of an infectious organism to cause disease. The third ability of pathogenic bacteria that allows them to avoid the body's immune mechanisms. Virulence factors describe the tendency of pathogenic organisms to cause disease, through traits such as invasion and toxin production [2].

In addition, the body's immunity factor also plays an important role in determining whether the disease will develop after transmission of bacterial agents. The body's immunity is strongly influenced by genetic factors, nutritional status, age, duration of exposure to the organism, Environmental Hygiene and comorbid history [2].

During treatment in people who have bacterial infections will be carried out various therapies ranging from supportive to definitive therapy, especially in definitive therapy will be given antibiotics aimed at eradication of bacteria. But there are some real challenges in the use of antibiotic therapy despite the high cases of antibiotic resistance, but there are also allergic conditions to drugs ranging from antibiotics to other supportive therapies.

* Corresponding author: Ichsanto Permadi.

All drugs have the potential to cause side effects, also known as 'adverse drug reactions', but not all of them are allergic. Other reactions are idiosyncratic, pseudo-allergic or caused by drug intolerance. The British Society for Allergy and Clinical Immunology (BSACI) defines drug allergy as an adverse drug reaction with a clear immunological mechanism. Based on that drug allergy is defined as any reaction caused by a drug with a clinical picture corresponding to immunological mechanisms[3]. In this article, we will review the case of patients who experience bacterial infections accompanied by adverse drug reactions conditions.

2. Case Report

One patient were admitted to the Internal Medicine department of SIS AlJufri Hospital between March 24, 2024, and April 6, 2024. The first characteristics of patient coughing and tightness, image examinations and laboratory examination items of patient are listed in Table 1. & Table 2. The details for patient are provided below

2.1. Case 52-year-old female

A 52-year-old female, presented with coughing and tightness 2 days ago, the patient complained that her chest also felt heavy and depressed when breathing. The patient previously had a history of bronchial asthma and TB post therapy has been completed treatment and on examination for SARS-CoV-2 antigen with negative results, the patient was treated for 12 days at SIS Aljufri hospital, Palu, Indonesia. On the 2nd day of treatment, the patient experienced Heartburn then given omeprazole injection therapy and Ketorolac injection, after giving the drug injection therapy patients complained of anxiety, chest heaviness accompanied by shortness of breath and then immediately given injection therapy. Dexamethasone injection, Diphenhydramine injection and oxygen administration via non-rebreathing mask 15 liters/minute, After treatment with Dexamethasone injection, diphenhydramine injection patient condition progressed better and on the 4th day of treatment, the patient was transferred to the intensive care unit (ICU), with post-anaphylactic shock and thorax X-ray examination results stated that there was cardiomegaly accompanied by pleura pneumonia, caused there is an infection and patient administered inj. Meropenem, after the administration Meropenem the patient then experienced anxiety and severe shortness, then the administration of Meropenem was stopped and given an Dexamethasone injection, Diphenhydramine injection and the patient's condition gradually improved.

At the 5th, 6th,7th day of treatment, patient condition progressed better and in stable condition and complaints of tightness and cough with phlegm decreased, but on the 8th treatment experienced a weak condition accompanied by hypotension, then given additional inotropic Vascon therapy and also Levofloxacin injection. On the 8th, 9th, 10th, 11th,12th day of treatment, the patient experienced progressed better condition, and on the 13th was able to talk normally without feeling tightness, able to move well and the patient was discharged.

2.1.1. Timeline & History Patient

The patient is treated for 12 days, during the treatment the patient is intensively monitored and periodic examinations are carried out related to patient complaints, vital signs to the necessary supporting examinations. During the treatment process, the patient's condition fluctuated, especially on the 3rd, 4th and 5th day and began to gradually stabilize on the 6th to 12th day, which then on the 13th day the patient was declared stable and had no complaints and was allowed to go home from the hospital and outpatient.

Table 1 Patient Clinical Course

Day	Subjective	Objective	Assessment	Planning
1	Cough and Tightness in chest area, heartburn, history of illness: Bronchial Asthma, TBC post Treatment (2 year)	GCS: Compos Mentis BP: 130/80 mmHg HR: 95-110/minute T: 36^{o}C RR: 26-28/minute SpO2: 92-94% (room air) Pulmo: Whezzing : +/+	Acute Exacerbation Of Bronchial Asthma	-O2 Nasal Canul -IVFD Ringer lactate -Nebulizer Combivent -Oral Salbutamol

		Lab: CBC (Table 2.)		
2	Heartburn	GCS: Compos Mentis BP: 130/70 mmHg HR: 79-86/minute T: 36^{o}C RR: 19-22/minute SpO2: 97-99% (O2 via NC) Pulmo: Whezzing : +/+ (decreased) Thorax X-ray: (Table 2.)	Bronchial Asthma Cardiomegaly Pneumoniae	-O2 Nasal Canul -IVFD Ringer lactate -Inj. Methylprednisolone -Inj. Omeprazol -Inj. Ketorolac -Nebulizer Combivent -Oral Salbutamol -Oral N-Acetylcysteine -Oral Azithromycin
	After administered Omeprazole and Ketorolac: Shortness of breath, anxiety, weakness and hypotension	GCS: Delirium BP: 90/80 mmHg HR: 109-120/minute T: 36^{o}C RR: 28-30/minute SpO2: 66-67% (O2 via Nasal Canul) Pulmo: Whezzing : +/+	Bronchial Asthma Cardiomegaly Pneumoniae Anaphylactic Shock	-Inj. Dexamethasone -Inj. Diphenhydramine -Inj. Methylprednisolone -Nebulizer Combivent -On Folley Catheter -Pro - ICU
3	Shortness of breath and weakness begins to decrease (Intensive Care Unit)	GCS: Compos Mentis BP: 90/60 mmHg HR: 80-112/minute T: 36^{o}C RR: 22-28/minute SpO2: 96-97% (O2 via NRM) Pulmo: Whezzing : +/+ Lab: CBC, Ureum-Creatinine, SGPT, Glucose level (Table 2.)	Bronchial Asthma Post Cardiomegaly Pneumoniae Post Anaphylactic Shock	-O2 via Non-Rebreathing Masker -IVFD Ringer lactate -Inj. Dexamethasone -Inj. Diphenhydramine -Inj. Methylprednisolone -Nebulizer Combivent -On Folley Catheter
4	Shortness of breath and weakness begins to decrease (Intensive Care Unit)	GCS: Compos Mentis BP: 97/55 mmHg HR: 75/minute T: 37^{o}C RR: 22/minute SpO2: 99% (O2 via NRM) Pulmo: Whezzing : +/+ (decreased)	Bronchial Asthma Post Cardiomegaly Pneumoniae Post Anaphylactic Shock	- O2 via Non-Rebreathing Masker -O2 via Non-Rebreathing Masker -IVFD Ringer lactate -Inj. Dexamethasone -Inj. Diphenhydramine -Inj. Methylprednisolone -Inj. Meropenem -Nebulizer Combivent -On Folley Catheter

	After administered Meropenem: Shortness of breath, anxiety, weakness (Intensive Care Unit)	GCS: Compos Mentis (anxiety) Blood Pressure: 90/55 mmHg HR: 75/minute T: 37^{o}C RR: 28-31/minute SpO2: 92% (O2 via NRM) Pulmo: Whezzing : +/+ (basal area)	Bronchial Asthma Cardiomegaly Pneumoniae Anaphylactic Shock (Exacerbation)	-Stop inj. Meropenem -Inj. Dexamethasone -Inj. Diphenhydramine -On Folley Catheter
5 6 7	Shortness of breath and weakness begins to decrease (Intensive Care Unit)	GCS: Compos Mentis BP: 97/60 – 103/60 mmHg HR: 75-86/minute T: 37^{o}C RR: 18-20/minute SpO2: 97-99% (O2 via NRM) Pulmo: Whezzing : -/-	Bronchial Asthma Cardiomegaly Pneumoniae Post Anaphylactic Shock	-O2 via Non-Rebreathing Masker -IVFD Ringer lactate -Inj. Dexamethasone -Inj. Diphenhydramine -Nebulizer Combivent -On Folley Catheter
8	Weakness and hypotension begin to decrease (Intensive Care Unit)	GCS: Compos Mentis BP: 77/44 mmHg HR: 75-86/minute T: 36^{o}C RR: 22/minute SpO2: 96-97% (O2 via NRM) Pulmo: Whezzing : -/- Lab: CBC, Glucose level (Table 2.)	Bronchial Asthma Cardiomegaly et Hypotension Pneumoniae Post Anaphylactic Shock	-O2 via Non-Rebreathing Masker -IVFD Ringer lactate -Inj. Dexamethasone -Inj. Diphenhydramine -Inj. Levofloxacin -Syringe Pump Vascon -Nebulizer Combivent -On Folley Catheter
9 10	Weakness begins to decrease (Intensive Care Unit)	GCS: Compos Mentis BP: 123/80 mmHg HR: 69-88/minute T: 36^{o}C RR: 22/minute SpO2: 97-99% (O2 via NC) Pulmo: Whezzing : -/-	Bronchial Asthma Cardiomegaly et Hypotension Pneumoniae Post Anaphylactic Shock	-O2 via Non-Rebreathing Masker -IVFD Ringer lactate -Inj. Dexamethasone -Inj. Diphenhydramine -Inj. Levofloxacin -Syringe Pump Vascon -Nebulizer Combivent -On Folley Catheter

11 12	Weakness begins to decrease (Intensive Care Unit)	GCS: Compos Mentis BP: 123/80 mmHg HR: 69-88/minute T: 36^{o}C RR: 22/minute SpO2: 97-99% (O2 via NC) Pulmo: Whezzing : -/- Lab: Glucose level (Table 2.)	Bronchial Asthma Cardiomegaly et Hypotension Pneumoniae Post Anaphylactic Shock	- O2 via Nasal Canul -IVFD Ringer lactate -Inj. Dexamethasone -Inj. Diphenhydramine -Inj. Levofloxacin -Oral Salbutamol -Oral Bromhexine Hydrochloride -Bladder Training -Breathing training
13	No complaints	GCS: Compos Mentis BP : 103/780 mmHg HR: 79/minute T: 36^{o}C RR: 19-21/minute SpO2: 97-99% (room air)	Bronchial Asthma Cardiomegaly et Hypotension Pneumoniae Post Anaphylactic Shock	Patient discharged from hospital

Note: GCS: Glasgow Coma Scale, BP: Blood Pressure, HR: Heart Rate, T: Temperature, RR: Respiration Rate, SpO2: Oxygen Saturation Peripheral, CBC: Complete Blood Count, IVFD: Intravenous Fluid Drop, Inj: Injection.

2.1.2. Laboratory and Radiology Finding

The results of laboratory and Radiological examinations, was found that the results were quite varied where the results when entering (march/24/2024) did not find certain abnormalities, and the next day (march/25/2024) a photo of the thorax AP found a picture of pleura pneumonia dextra, lymphadenopathy hilar sinistra, accompanied by cardiomegaly.

Interestingly, on April/01/2024 there was a significant increase in WBC of 18.820/ul, followed by an increase in neutrophil 83.4%, this can give the impression that there is an infection in the patient's body or the occurrence of a rejection reaction process of drug substances that have been given before, but both of these things have not been confirmed with certainty.

Table 2 Laboratory and Radiological

Day 1 - March/24/2024			**Day 2 - March/25/2024**		
	Result	Reference Values	Daily day	Result	Reference Values
WBC	7.710 /ul	4.000 - 11.000	blood glucose level	244 mg/dL	70-200
RBC	4.7 mill/ul	2,5 - 5,8			
Hb	13.3 g%	8 - 17	Photo thorax AP: (Figure 1)		
HCT	37 %	26 - 50	- asymmetric position		
TC	339.000 /ul	150.000 - 450.000	- inhomogeneous consolidation of the lower field of the right lung accompanied by an interrelation covering the right sinus and diaphragm		
BSR	16 mm/hours	0 - 20			
Neutrophil	72.9 %	37.0 - 72.0	- visible compaction of the left hilum		
Lymphocyte	13.4 %	20.0 - 50.0	- enlarged Cor impression, embedded apex (LVE), normal aorta		
Monocyte	12.5 %	0.0 - 14	- left sinus and diaphragm both		
Eosinophil	0.8 %	0.0 - 6.0	- bone visualized normal		
Basophil	0.4 %	0.0 - 0.1	Effects:		
rapid antigen/virology result: Negative			- pleura pneumonia dextre & lymphadenopathy hilar sinistre - Cardiomegaly		

Day 3 - March/26/2024

Every 2 H	Result	Values
blood glucose level	92 mg/dL	70-200
blood glucose level	119 mg/dL	70-200
blood glucose level	116 mg/dL	70-200
blood glucose level	104 mg/dL	70-200

	Result	Reference Values
WBC	5.560 /ul	4.000 - 11.000
RBC	3.7 mill/ul	2,5 - 5,8
Hb	10.8 g%	8 - 17
HCT	30 %	26 - 50
TC	82.000/ul	150.000 - 450.000
BSR	0 mm/hours	0 - 20
Neutrophil	81.8 %	37.0 - 72.0
Lymphocyte	8.5 %	20.0 - 50.0
Monocyte	9.7 %	0.0 - 14
Eosinophil	0.0 %	0.0 - 6.0
Basophil	0.0 %	0.0 - 0.1
Creatinine	0.9 mg/dL	0.5-1.6
SGPT	13 u/L	4-36
Ureum	44 mg/dL	8-53

Day 8 - April/01/2024

Daily day	Result	Reference Values
blood glucose level	84 mg/dL	70-200

	Result	Reference Values
WBC	18.820 /ul	4.000 - 11.000
RBC	4.4 Mill/ul	2,5 - 5,8
Hb	12.5 g%	8 - 17
HCT	35 %	26 - 50
TC	405.000 /ul	150.000 - 450.000
BSR	- mm/hours	0 - 20
Neutrophil	83.4 %	37.0 - 72.0
Lymphocyte	9.0 %	20.0 - 50.0
Monocyte	7.3 %	0.0 - 14
Eosinophil	0.2 %	0.0 - 6.0
Basophil	0.1 %	0.0 - 0.1

Day 12 - April/04/2024

Daily day	Result	Reference Values
blood glucose level	176 mg/dL	70-200

Note: WBC: White Blood Cell, RBC: Red Blood Cell, Hb: Hemoglobin, HCT: Hematocrit, BSR: Blood Sedimentation Rate, TC: Thrombocyte, H: Hours

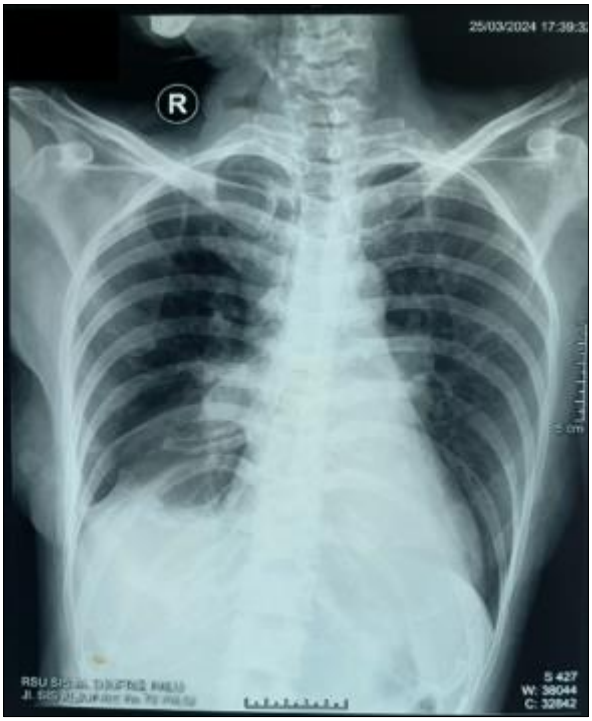

Figure 1 Thorax Photo AP (*Anterior-Posterior*) 52-year-old female

3. Discussion

One of the most common acute respiratory infections affecting the alveoli and distal airways is Pneumonia, which is generally divided into community-acquired pneumonia (CAP) or hospital-acquired pneumonia (HAP) [4]. Pneumonia one of the most frequent infections leading to death, in 2019 was suspected in 80% of cases of death in children in South Asia and Africa [5]. In the case of nosocomial infections cause 5 cases out of 10 patients every 1,000 treatments with a mortality rate of about 20-30% [6,7].

In several studies that have been conducted worldwide, of a total of 82,674 pneumonia patients 33-50% caused by *Streptococcus pneumoniae*, 7-16% caused by *Haemophilus influenzae*, about 26.9% caused by *Klebsiella pneumoniae* [8,9]. So based on this recommendation, the use of antibiotics as therapy is the most rational thing. Some of the commonly recommended antibiotics such as serotonergic lactam and combination inhibitors, especially sulbactam-ampicillin (SAM) and ceftriaxone, in the initial therapy cases [10,11].

Basically, lung is a sterile area, normally there is a microbiome in lung such as *Streptococcus spp.* and *Mycoplasma spp* [12]. Which serves as a defense of the respiratory system. Disruption of the defense system Pulmo trigger exposure to pathogenic microorganisms originating from external conditions causing overgrowth and displace the normal flora and impact the occurrence of infection [13].

The infectious process begins with acute inflammation of alveolar cells, in pneumonia triggered by bacterial activation of neutrophils can occur, in case of viral pneumonia lymphocyte activity occurs, as well in fungal and mycobacterial pneumonia can occur granulomatous inflammation, this condition will provide a radiological pattern of consolidation on chest X-ray [13].

3.1. Antibiotic in Pneumonia

According to the National Institute for Health and Clinical Excellence (NICE) guidelines, adults, young adults and children who have been diagnosed with pneumonia should be hospitalized and given antibiotics. The use and selection of antibiotics is based on the severity of the patient's condition, the duration of symptoms until the hospital treatment, antibiotic resistance data at the local hospital, History of previous antibiotic use and side effects and unexpected things during antibiotic use [14].

In addition, immediately start the administration of antibiotics 4 hours after the patient is diagnosed, and consider the use of first-line oral antibiotics if the patient allows to take the medicine orally. In the use of antibiotics intravenously if via oral is not possible and the severity of the patient's condition, then immediately do a microbiological examination of the patient's sputum to ensure the bacterial agent that causes pneumonia in the patient [14].

In the selection of antibiotics in the case of hospital-acquired pneumonia based on the NICE guideline, there are several things that are considered, one of them is the patient's age, the risk of resistance, the general condition of the patient who will determine the selection and route of the Medication [15,16]

Table 3 Antibiotics in the case of hospital-acquired pneumonia based on the NICE guideline [15,16]

No.	Age Category	Medication Routes of Administration	Treatment	Antibiotic, dosage and course length
1.	Antibiotics for adults aged 18 years and over	Via Oral	First-choice oral antibiotic if non-severe symptoms or signs, and not at higher risk of resistance (guided by microbiological results when available)	Co-amoxiclav: 500/125 mg three times a day for 5 days then review
			Alternative oral antibiotics if non-severe symptoms or signs, and not at higher risk of resistance, for penicillin allergy or if co-amoxiclav unsuitable (based on specialist	Doxycycline: 200 mg on first day, then 100 mg once a day for 4 days (5-day course) then review
				Cefalexin (caution in penicillin allergy):

			microbiological advice and local resistance data)	500 mg twice or three times a day (can be increased to 1 g to 1.5 g three or four times a day) for 5 days then review
				Co-trimoxazole: 960 mg twice a day for 5 days then review
				Levofloxacin (only if switching from intravenous levofloxacin with specialist advice): 500 mg once or twice a day for 5 days then review
		Via Intravenous	First-choice intravenous antibiotics if severe symptoms or signs (for example, symptoms or signs of sepsis) or at higher risk of resistance (based on specialist microbiological advice and local resistance data)	Piperacillin with tazobactam: 4.5 g three times a day (increased to 4.5 g four times a day if severe infection)
				Ceftazidime: 2 g three times a day
				Ceftriaxone: 2 g once a day
				Cefuroxime: 750 mg three times a day (increased to 750 mg four times a day or 1.5 g three or four times a day if severe infection) [amended October 2020]
				Meropenem: 0.5 g to 1 g three times a day
				Ceftazidime with avibactam: 2/0.5 g three times a day
				Levofloxacin (only if other first-choice antibiotics are unsuitable): 500 mg once or twice a day (use higher dosage if severe infection)
			Antibiotics to be added if suspected or confirmed meticillin-resistant Staphylococcus aureus infection (dual therapy with a first-choice intravenous antibiotic)	Vancomycin: 15 mg/kg to 20 mg/kg two or three times a day intravenously, adjusted according to serum vancomycin concentration (a loading dose of 25 mg/kg to 30 mg/kg can be used in seriously ill people); maximum 2 g per dose
				Teicoplanin: Initially 6 mg/kg every 12 hours for 3 doses, then 6 mg/kg once a day intravenously
				Linezolid (if vancomycin cannot be used; specialist advice only): 600 mg twice a day orally or intravenously

2.	Antibiotics for children and young people under 18 years	Via Oral	Choice for children under 1 month	Antibiotic choice based on local resistance data and specialist microbiological advice
			First choice oral antibiotic for children aged 1 month and over if non-severe symptoms or signs and not at higher risk of resistance (guided by microbiological results when available)	Co-amoxiclav: 1 month to 11 months, 0.5 ml/kg of 125/31 suspension three times a day for 5 days, then review 1 year to 5 years, 10 ml of 125/31 suspension (or 5 ml of 250/62 suspension) three times a day, or 0.5 ml/kg of 125/31 suspension three times a day for 5 days, then review 6 years to 11 years, 10 ml of 250/62 suspension three times a day or 0.3 ml/kg of 250/62 suspension three times a day for 5 days, then review 12 years to 17 years, 500/125 mg three times a day for 5 days, then review
			Alternative oral antibiotic for children aged 1 month and over if non-severe symptoms or signs and not at higher risk of resistance, for penicillin allergy or if co-amoxiclav unsuitable (other options may be suitable based on specialist microbiological advice and local resistance data)	Clarithromycin: 1 month to 11 years: Under 8 kg, 7.5 mg/kg twice a day for 5 days, then review 8 kg to 11 kg, 62.5 mg twice a day for 5 days, then review 12 kg to 19 kg, 125 mg twice a day for 5 days, then review 20 kg to 29 kg, 187.5 mg twice a day for 5 days, then review 30 kg to 40 kg, 250 mg twice a day for 5 days, then review 12 years to 17 years, 500 mg twice a day for 5 days, then review
		Via Intravenous	First-choice intravenous antibiotics if severe symptoms or signs (for example, symptoms or signs of sepsis), or at higher risk of resistance (antibiotic choice should be based on specialist microbiological advice and local resistance data)	Piperacillin with tazobactam: 1 month to 11 years, 90 mg/kg three or four times a day (maximum 4.5 g per dose four times a day) 12 years to 17 years, 4.5 g three times a day (increased to 4.5 g four times a day if severe infection)
				Ceftazidime: 1 month to 17 years, 25 mg/kg three times a day (50 mg/kg three times a day if severe infection; maximum 6 g per day)
				Ceftriaxone:

				1 month to 11 years (up to 50 kg), 50 mg/kg to 80 mg/kg once a day (use dose at higher end of range if severe infection; maximum 4 g per day) 9 years to 11 years (50 kg and above), 2 g once a day 12 years to 17 years, 2 g once a day
			Antibiotics to be added if suspected or confirmed meticillin-resistant Staphylococcus aureus infection (dual therapy with a first-choice intravenous antibiotic)	Teicoplanin: 1 month, initially 16 mg/kg for 1 dose, then 8 mg/kg once daily, subsequent dose to be given 24 hours after initial dose (doses given by intravenous infusion) 2 months to 11 years, initially 10 mg/kg every 12 hours intravenously for 3 doses, then 6 mg/kg to 10 mg/kg once daily intravenously 12 years to 17 years, initially 6 mg/kg every 12 hours intravenously for 3 doses, then 6 mg/kg once daily intravenously
				Vancomycin: 1 month to 11 years, 10 mg/kg to 15 mg/kg four times a day intravenously, adjusted according to serum-vancomycin concentration 12 years to 17 years, 15 mg/kg to 20 mg/kg two or three times a day intravenously, adjusted according to serum vancomycin concentration (a loading dose of 25 mg/kg to 30 mg/kg can be used in seriously ill people); maximum 2 g per dose
				Linezolid (if vancomycin cannot be used; off-label use; specialist advice only): 3 months to 11 years, 10 mg/kg three times a day orally or intravenously (maximum 600 mg per dose) 12 years to 17 years, 600 mg twice a day orally or ntravenously

3.2. Adverse Drug Reactions

Since the first mechanism of occurrence and clinical picture of the condition of adverse drug reactions (ADR) is diverse. Rawlings and Thompson in 1977 and 1981, proposed a subclassification of ADR, which is still used today, namely:

- Type A reactions are caused by the pharmacological activity of the drug, influenced by the dose of the drug, pharmacokinetics, comorbidities and/or drug-drug interactions. In this type A reaction gives term to condition called “Overdose” and drug binding to receptors outside the target is the core of this type of "pharmacological" reaction, then the condition of Type A reactions can occur in any individual and to some extent predictable [17,18,21].

- Type B reactions are not yet well defined, because there are various mechanisms that still need further research such as enzyme deficiency conditions, accumulation of reactive oxygen species and damage to red blood cells are still included in the subclassification of Type B reactions, which are not purely due to immune reactions and not hypersensitivity. Most Type B reactions are mechanisms of the immune system and drug hypersensitivity reactions (DHR). The term" drug allergy " refers to a specific immune response to a drug acting as a hapten, which is actually directed against the hapten-carrying complex. This complex serves as an allergen [19,20,21].

3.2.1. Drug Hypersensitivity Reactions Due Antibiotic

Antibiotics are very important in the case of bacterial infections and become one of the greatest achievements in the world of Medicine. But behind the successful role of antibiotics in eradicating bacterial infectious diseases, there is a condition that drug hypersensitivity reactions (DHR) can exclude some patients from using this drug. The DHR classification system by Gell and Coombs classifies by immunological mechanism into four categories (types I-IV) [22,23,24,25,26,27,28]:

- Type I reactions: are direct and IgE-mediated, in which specific IgE antibodies to allergens bind to mast cells and trigger the release of mediators such as histamine and leukotrienes, as well as triggering vasodilation mechanisms and increased capillary permeability.

- Type II reactions: are the result of antibodies binding to cell surface antigens, leading to antibody-dependent cell-mediated cytotoxicity.

- Type III reactions: caused by the development of the formation of immune complexes that settle in the vascular and tissues, and activate the complement system that releases inflammatory mediators.

- Type IV reaction: it is mediated by T cells and occurs when T cells are sensitive to antigens. The Antigen, in this case the drug itself or its metabolites, can then bind to serum or cell-bound proteins, creating an immunogenic molecule, which activates presentation to T cells. Type IV reactions are further subcategorized into four groups (IVa, IVb, IVc, IVd) depending on the specific T cell type involved [22,23,24,25,26,27,28].

Table 4 Immune-mediated antibiotic hypersensitivity reactions [22,23,24,25,26,27,28]

No.	Type	Description	Pathogenesis	Onset of Reaction	Typical Clinical Findings	Commonly Associated Antibiotics
1	I (Immediate)	IgE-mediated hypersensitivity	Antibiotic-specific IgE binds to Fc-epsilon-RI receptors on mast cells and basophils. Subsequent antibiotic exposure leads to mast cell and basophil degranulation	<1 hours	Anaphylaxis, hives, angioedema, N/V, abdominal pain, SOB, wheezing, anxiety, confusion, chest pain, palpitations, syncope, cardiac arrest	Cephs, FQs, PCNs,
2	II (Delayed)	Antibody-mediated hypersensitivity	Antibiotic binds to WBC, RBC, or platelet and acts	7–14 days	Hemolytic anemia, thrombocytopenia, neutropenia	Cephs, PCNs, SMX/TMP

			as antigen leading to antibody (usually IgG or complement) mediated cell destruction			
3	III (Delayed)	Immune complex mediated hypersensitivity	Antibiotic and IgG/IgM bind to form immune complex activate complement	7–14 days	Serum sickness *, vasculitis	Cephs (esp cefaclor), cipro, PCNs, SMX/TMP
4	IV (Delayed) Delayed type hypersensitivity		Antigen specific T-cell activation			
			IVa (Monocytic inflammation (Th1 and IFN-γ)	10–15 days	Allergic contact dermatitis	Topical neomycin, bacitracin, polymyxin
			IVb (Th2-mediated eosinophilic inflammation)	2–8 week (for DRESS)	DRESS	PCNs, Cephs, Dapsone, Minocycline SMX/TMP, Vanco
			IVc (CD8 T cell-mediated cytotoxicity)	4–28 days	SJS, TEN	FQs, Nevirapine, PCNs,SMX/TMP
			IVd (T-cell-mediated neutrophilic inflammation)	24–48 hours	AGEP	Ampicillin, Antifungals, FQs, SMX/TMP

AGEP: Acute generalized exanthematous pustulosis. Cephs: cephalosporins. DRESS: drug rash with eosinophilia and systemic symptoms. FQ: flouroquinolones. N/V: nausea/vomiting. PCNs: penicillins. RBC: red blood cell. WBC: white blood cell. SJS: Steven Johnson Syndrome. SMX/TMP: sulfamethoxazole/trimethoprim. SOB: shortness of breath. TEN: Toxic epidermal necrolysis. Vanco: vancomycin.

4. Conclusion

The journey since discovery of antibiotics has become one of the most miracle and have huge impact drugs in the world of Medicine, and has variety benefits, especially in dealing with infectious diseases. Behind the huge potential and benefits in term use antibiotics must be done carefully because there are several cases of rejection reactions or known as Drug Hypersensitivity Reactions or drug allergy.

In this case the patient is suspected of having a condition of Drug Hypersensitivity Reactions, due to meropenem antibiotics, as we know Meropenem is a broad-spectrum carbapenem antibiotic. It is active against Gram-positive and Gram-negative bacteria. Meropenem exerts its action by penetrating bacterial cells readily and interfering with the synthesis of vital cell wall components, which leads to cell death.

But in this case review, our authors have not been able to definitively confirm the condition of Drug Hypersensitivity Reactions in the use of meropenem, because in the process of allergic conditions can overlap also due to the patient's asthma history or not doing meropenem allergy tests specifically for patients. This is one of a limitation the author in this case review.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors have no conflicts of interest regarding this case review.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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