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MORALITY BEFORE KNOWLEDGE

Effectiveness of co-amoxiclav antibiotic therapy in carbuncle patients with type II diabetes mellitus

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ABSTRACT

Background: Carbuncle is a confluent folliculitis that is infection affecting multiple hair follicles leading to multiple sinuses discharging pus. Optimisation of co-morbidities such as diabetes, adequate hydration, and antibiotics and are mainstay of initial treatment. Surgical intervention in the form of debridement and desloughing followed by wound care is the next line of management. The aim of this study was to know the effectiveness of co-amoxiclav antibiotic therapy in carbuncle patients with type II diabetes mellitus at the Surgical Polyclinic of Sabu Raijua Regional Hospital. **Methods:** This type of research is quantitative research using a cross-sectional retrospective approach. The sample in this study was patient data collection through medical records from 2023 to 2024 who underwent co-amoxiclav therapy of 1000 mg every 8 hours orally for 10 days accompanied by incision drainage with local anesthesia of 2% lidocaine with a carbuncle size of >10 cm who were treated at the Surgical Polyclinic of Sabu Raijua Hospital, totaling 10 patients. **Findings:** The results of therapy with co-amoxiclav antibiotic 1000 mg every 8 hours orally for 10 days accompanied by incision drainage with local anesthesia lidocaine 2% with carbuncle size >10 cm who received treatment were 10 patients who successfully recovered with outpatient care, did not experience complications or readmissions. **Conclusion:** In early-stage carbuncle cases, treatment with oral co-amoxiclav antibiotics alone is possible and effective, although incision and drainage should still be performed as early as possible. **Novelty/Originality of this Article:** This study demonstrates the effectiveness of the combination of oral co-amoxiclav 1000 mg/8 hours for 10 days with incision-drainage in carbuncles >10 cm with type II DM, which can be successfully treated as an outpatient without complications or readmissions.

KEYWORDS: carbuncle; co-amoxiclav; diagnosis.

1. Introduction

Boils refer to a pathological condition where infection originating in an adjacent hair follicle spreads to the surrounding skin and deeper subcutaneous tissue. Typical symptoms include a tender, erythematous, abscessed mass with multiple surface drainage sites. Local lymph node swelling may occasionally accompany the condition. Common sites include the posterior neck, back, and thigh skin areas.

The lesion usually originates from a single follicular infection. The primary pathogen is *Staphylococcus aureus*; if healing is prolonged, secondary infection with methicillin-resistant *Staphylococcus aureus* (MRSA) frequently occurs (Ahmad & Siddiqui, 2017; Akram et al., 2021). Anaerobic bacteria may also be detected. These organisms are commonly present in the skin flora of the inguinal region, axillae, neck, and buttocks, and are also part of the normal flora of the anterior nares. Transmission via scratching can occur, particularly

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in patients with poor personal hygiene. When skin integrity is compromised, bacteria invade the tissue. Bacteria colonizing deep skin layers proliferate, causing follicular infection (furuncle). If the infection spreads to adjacent hair follicles, it forms a nodular mass with multiple pus-draining openings, termed a boil. The precise incidence of boils varies. This disease is more common in men and particularly favors patients with compromised skin barrier function due to conditions such as eczema, diabetes, alcohol abuse, malnutrition, immunodeficiency, obesity, or unsanitary living environments (Akram et al., 2021). MRSA (Methicillin-resistant *Staphylococcus aureus*) carriers are frequently found among individuals in nursing homes and densely populated environments (Balintescu et al., 2022) .

Many patients also have diabetes. In the early stages of the lesion, the pustules reported by patients appear as slowly enlarging, tender nodules. Over time, the lesions expand, accompanied by worsening redness, swelling, and tenderness. Multiple pustules develop in the skin area, rupturing and draining pus with minor trauma. Patients often present with systemic symptoms such as fever, fatigue, and weakness, and local lymph node swelling may occur. Gangrene most commonly develops on the occipital region and upper back, and also occurs in moist areas such as the axillae and inguinal regions (Balintescu et al., 2022).

The appearance of gangrene is diagnostically significant. Extensive skin darkening occurs, with pus draining from multiple fistulae. The surrounding skin presents erythema with tenderness, and induration may be present. This can resemble other skin lesions such as cystic acne (typically solitary small pustules) (Chang et al., 2019).

Cellulitis presents a similar appearance but lacks the nodular or pustular distribution pattern. Hidradenitis suppurativa is highly similar to carbuncles (Chang et al., 2019). However, its predilection for the axillary and inguinal regions and chronic course are the primary distinguishing features from axillary abscesses. Rare conditions such as ORF (oral herpes) due to viral infection or cutaneous anthrax may also present with gangrenous-like symptoms (Gheisari et al., 2021). Without appropriate treatment, lesions may persistently expand, potentially involving extensive skin areas, particularly on the back. In immunocompromised patients, rapid lesion expansion may lead to life-threatening complications like sepsis and, rarely, dangerous complications such as cavernous sinus thrombosis.

Amoxicillin-Clavulanate Potassium is a drug used to treat bacterial infections of the respiratory tract, ear, urinary tract, skin, and bones/joints. This product is a combination of amoxicillin and clavulanic acid. Amoxicillin belongs to the penicillin class of antibiotics. Amoxicillin-clavulanate combination therapy is used to treat bacterial infections in multiple body sites (e.g., ear, lung, sinus, skin, urinary tract). Amoxicillin-clavulanate combination therapy is classified as a penicillin antibiotic and a β-lactamase inhibitor antibiotic.

Sabu Raiju is a regency in East Nusa Tenggara Province. Data indicates a significantly high number of abscess cases in this regency. From 2023 to 2024, the surgical outpatient department at Sabu Raiju Regional General Hospital treated 10 abscess cases. Located in a remote area of the Indonesian archipelago, Sabu Raiju Regency has limited healthcare personnel and infrastructure, resulting in abscess cases not receiving optimal treatment. Against this backdrop, the author conducted a study to evaluate the efficacy of carmoxilin antibiotic therapy for gangrene patients with type II diabetes at the Sabrajuah Hospital Surgical Outpatient Department. This study aims to provide reference material for improving the standard of care for gangrene cases in the district, specifically for the surgical outpatient department at Sabu Raiju Hospital, which operates under conditions of limited medical personnel and equipment.

2. Methods

To determine the effectiveness of co-amoxiclav antibiotic therapy in carbuncle patients with type II diabetes mellitus at the Surgical Polyclinic of Sabu Raijua Regional Hospital. The method used in this study is Quantitative Research with a retrospective cross-sectional study design to see and observe cases that occur. The sample in this study were carbuncle

patients registered and treated at the Surgical Polyclinic of Sabu Raijua Regional Hospital, namely 10 cases recorded from 2023-2024. The sample determination in the study used a saturated sample where all populations were used as research samples totaling 10 cases with the criteria of arbuncle cases measuring >10 cm treated at the Surgical Polyclinic of Sabu Raijua Regional Hospital. This study was conducted from January-March 2025.

3. Results and Discussion

3.1 Research results (carbuncle case reporting and handling)

3.1.1 Report of one patient with carbuncle case

A 53 year old man was admitted to the hospital on January 12, 2025, with complaints of pain and swelling in the back accompanied by purulent and black wounds for 3 weeks with wounds that were getting wider. Complaints were accompanied by fever and mouth ulcers. The patient has a history of wounds on both legs 1 month ago. A history of wounds on both lower limbs one month prior was confirmed. The patient has a history of diabetes for about 1 year but has not received treatment. Blood pressure 90/60 mmhg, RR 24x/minute, S 36.6 C, N 68x/minute, weight around 60 Kg, high around 165 cm. On physical examination, the patient was conscious, appeared reddish and swollen widely on the back measuring 15 cm x 15 cm. There were several spots on the surface and pus coming out. A complete blood count showed leukocytes 16.9 x 10 to the power of 9/L, platelets 333x10 to the power of 9/L, red blood cells 4.21x10 to the power of 12/L, Hemoglobin 9.9 g/dl, Glucose 409mg/dl, albumin 1.7 g/dl, urea 27 mg/dl, creatinine 0.6 mg/dl; leading to a diagnosis of diabetes mellitus with diabetic ketoacidosis and a large abscess secondary to this condition. This case demonstrates that uncontrolled diabetes can progress to severe skin and soft tissue infection, emphasizing the importance of proper glycemic control and surgical intervention.

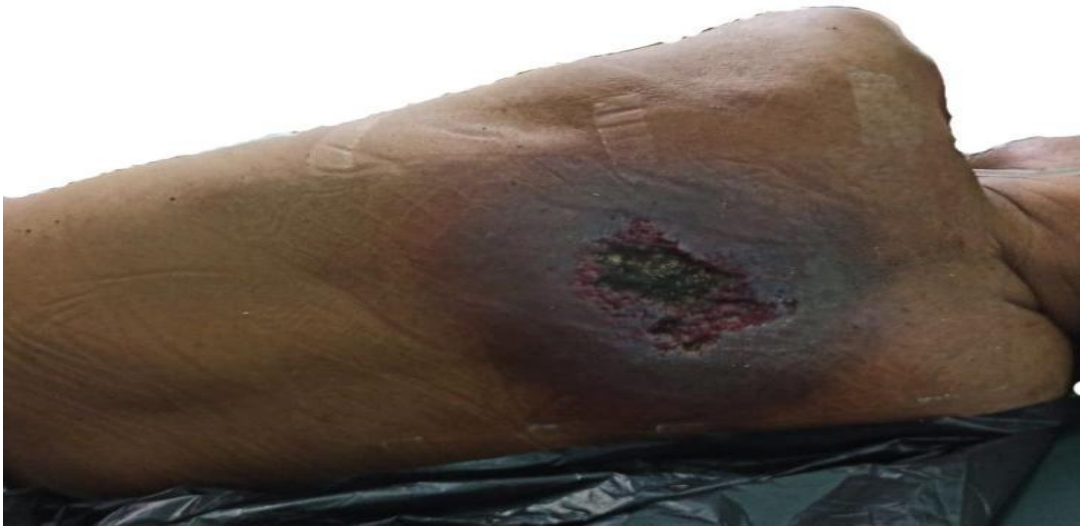
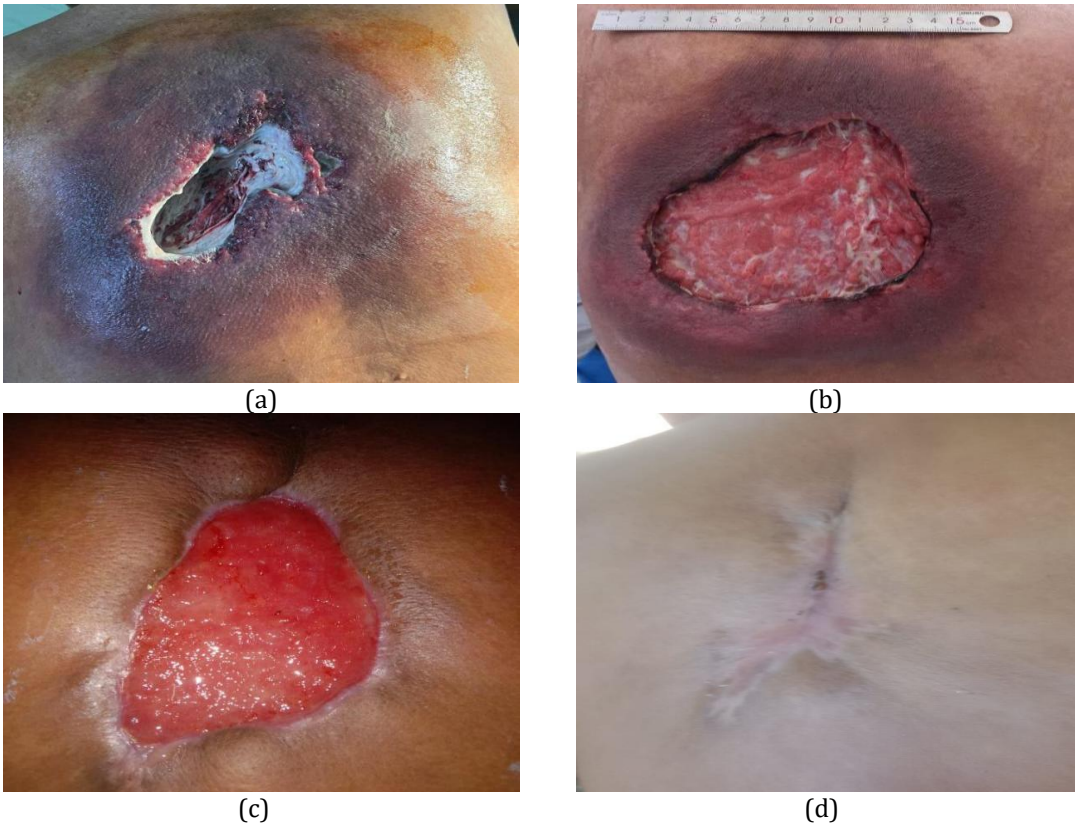


Fig 1. Appearance of carbuncle with multiple pus points, necrotic center, cellulitis with induration

3.1.2 Administration and results of therapy with co-amoxiclav antibiotics

This patient was given therapy with co-amoxiclav antibiotic 1000 mg every 8 hours orally for 10 days accompanied by incision drainage with local anesthesia of 2% lidocaine with a carbuncle size of >10 cm who was treated at the Surgical Polyclinic of Sabu Raijua Hospital. The results of therapy with the antibiotic co-amoxiclav 1000 mg every 8 hours orally for 10 days accompanied by incision drainage with local anesthesia lidocaine 2% with a carbuncle size of >10 cm who received treatment, the patient successfully recovered with

outpatient care, did not experience complications or readmissions. The patient was discharged with a reduced wound without complications. Antibiotics were replaced with oral cefixime 2x100 mg for 5 days and blood sugar control medication. The patient was scheduled for weekly check-ups to monitor wound healing. The patient did not experience readmission after drainage. This suggests that combined treatment with co-amoxiclav and surgical drainage may be an effective outpatient-based treatment option for large boils in patients with diabetes. It is considered a viable treatment strategy, particularly applicable in areas with limited medical infrastructure.



(a) (b) (c) (d)

Fig. 2 Update patient results (a) day 0 Before administration of co-amoxiclave 1000 mg therapy and before incision and drainage; (b) day 5 after administration of co-amoxiclave 1000 mg therapy and after incision and drainage; (c) day 5 after administration of co-amoxiclave 1000 mg therapy and after incision and drainage; (d) day 10 after administration of co-amoxiclave 1000 mg therapy and after incision and drainage

3.2 Discussion

Based on the results of therapy with the antibiotic Co-Amoxiclave 1000 mg every 8 hours orally for 10 days accompanied by incision drainage with local anesthesia lidocaine 2% with a carbuncle size of >10 cm who received treatment, 10 patients were successfully cured with outpatient care, without complications or readmissions. Carbuncle is a combination of several furuncles that form an inflammatory mass with a necrotic center in the middle. It begins as a furuncle that affects areas with thick skin such as the nape and back (Akram et al., 2022). The majority of carbuncle sufferers are patients with diabetes mellitus. This condition appears initially as a soft nodule that grows slowly as a pustule. This nodule becomes larger, redder and softer over a certain period.

A carbuncle refers to an infection originating in multiple adjacent hair follicles that has spread to the surrounding skin and deeper subcutaneous tissue. It typically presents as a red, painful mass with multiple pus-draining channels (furuncles) on the surface, often appearing red and palpable with fluid. It may be accompanied by enlarged local lymph nodes and commonly occurs on the back of the neck, back, and thigh skin.

The infection usually originates from inflammation of a single hair follicle (furuncle), with *Staphylococcus aureus* being the primary causative pathogen. Chronic cases are frequently caused by methicillin-resistant *Staphylococcus aureus* (MRSA). This bacterium is a normal resident flora found on the skin of areas like the groin, armpits, neck, buttocks, and within the nasal passages. When skin integrity is compromised, such as through scratching in conditions of poor personal hygiene, the bacteria successfully invade the tissue. Once established deep within the skin, they multiply, causing follicular infection. This infection spreads to adjacent follicles, forming a large, hard mass—a boil—that discharges pus through multiple openings. It is more commonly observed in males, particularly those with predisposing factors such as atopic dermatitis, diabetes, alcoholism, malnutrition, immunosuppression, obesity, or poor personal hygiene. MRSA carriage is frequently found in individuals residing in nursing homes or crowded environments.

Most patients have diabetes. The disease manifests as a slowly growing, painful nodule described by patients as a pustule. The lesion enlarges over time, becomes redder, and increases in pain. Multiple pustules develop in certain skin areas, rupturing with minor trauma to discharge pus. Patients may also exhibit systemic symptoms such as fever, general malaise, and fatigue. The most common sites are the back of the neck and upper back, though it can also occur in moist areas like the armpits and groin.

The appearance of the boil is diagnostic. A significant area of skin darkens, and multiple pustules discharge pus. The surrounding skin is reddened, tender, and may feel firm on palpation. This can resemble cystic acne, which typically presents smaller and with a single pustule. Cellulitis may also have a similar appearance but does not show a nodular or pustular pattern. Pyoderma gangrenosum closely resembles a boil, but the key distinguishing features are its preference for the axilla and groin and its chronic course. Other rare conditions, such as ORF caused by viral infection or cutaneous anthrax, can sometimes mimic a boil. Without treatment, the lesions expand, potentially involving large areas of the back skin. In immunocompromised states, rapid lesion spread can lead to fatal complications like sepsis, as well as rare and dangerous complications such as cavernous sinus thrombosis.

Patients require investigation after admission. Swab specimens should be obtained from lesions and sent for culture and antibiotic susceptibility testing. Blood tests should include blood glucose, glycated hemoglobin (HbA1c), and renal function assessment. Prompt intervention is essential, and local treatment should be initiated immediately. Management of comorbidities (especially blood glucose control), adequate hydration, and initiation of antibiotic therapy are critical. Cephalosporins or dicloxacillin are typically used in most cases. Specific antibiotic therapy should be initiated after swab test results. For MRSA-positive lesions, clindamycin may be started. Applying cold compresses with magnesium sulfate solution to the affected area helps reduce tissue edema, localize pus, and prevent the spread of surrounding necrosis.

Surgical intervention is required once blood glucose control is achieved at an acceptable level. Debridement (removal of necrotic tissue) is performed to remove infected necrotic tissue down to the subcutaneous level until fresh bleeding is observed at the base and edges. Additional desloughing sessions may be required to completely remove all dead necrotic tissue. This should be followed by chemical desloughing using EUSOL solution. The wound should be irrigated daily with a large volume of diluted hydrogen peroxide solution, followed by saline. Small amounts of necrotic tissue are removed by packing the crater-like wound with gauze soaked in EUSOL solution. EUSOL achieves chemical desloughing, and the free chlorine released from EUSOL also helps reduce bacterial counts. The use of ointments containing papain and urea is also recommended to remove small islands of necrotic tissue.

Once granulation tissue begins to form in the ulcer core, use granulation tissue promoters such as medications containing placental extract or, if possible, acriflavine solution. The goal of local therapy is to convert the lesion into a healing ulcer, which typically exhibits three zones (red zone, blue zone, white zone) progressing from the center to the periphery. Often, these ulcers initiate hypergranulation; using a 3% hypertonic saline

dressing helps prevent hypergranulation and reduce ulcer exudate. Peripheral fibrosis is also promoted, causing intestinal contraction and thereby reducing the ulcer's surface area.

Due to the large area of the healing ulcer, thin split-thickness skin grafting is recommended to enhance rapid skin coverage and the healing process. However, bacterial culture testing for pus must be negative before considering split-thickness skin grafting. Once healed, specific precautions should be provided to the patient to prevent recurrence of such lesions.

Meanwhile, a carbuncle is a necrotic infection where multiple furuncles coalesce into one and drain through multiple pores. Carbuncles are typically observed in immunocompromised patients and are recognized as a complication of diabetes. Carbuncles are commonly found on the neck and back, and the majority of patients often delay treatment for up to two weeks after onset. If treatment is delayed due to underlying comorbidities, a carbuncle can be fatal. Sedik et al. reported a case of a giant neck carbuncle with intracranial complications, concluding that an aggressive surgical approach is necessary for debridement of necrotic tissue.

The most common pathogen in boils is *Staphylococcus aureus*, which may be methicillin-sensitive or -resistant. This pathogen disrupts the integrity of the skin and subcutaneous tissue, forming interconnected abscesses with a porous drainage tract. The typical clinical feature of a boil is superficial skin swelling with porous drainage, its borders defined by irregular necrosis resulting from peripheral capillary occlusion. *Staphylococcus aureus* was cultured in all cases in our case series and was susceptible to the administered antibiotics. While awaiting culture results, first-generation cephalosporins, amoxicillin/clavulanate, or clindamycin were proposed as first-line antibiotics.

Several pustules develop in areas of skin rupture due to minor trauma that discharge pus. In advanced cases, the inflamed reddish areas turn black in the center. Patients experience systemic symptoms of fever, malaise, fatigue and regional lymphadenopathy may appear (Hee, & Jin, 2019). Differential diagnosis includes actinomycosis, bite reaction, gas gangrene, and cutaneous anthrax. Blood tests need to be done when the patient is admitted to the hospital including evaluation of blood sugar, h1bac, and kidney function. Swabs from the lesion should be collected for smear culture and antibiotic sensitivity testing (Hee, & Jin, 2019). In more complete health facilities, soft tissue ultrasonography and computed tomography can be performed so that the image of soft tissue thickening and increased echogenicity with fat lobulation can be seen.

Co-Amoxiclav is a medication used to treat bacterial infections of the respiratory tract, ears, urinary tract, skin, and bones and joints. This medication contains a combination of amoxicillin and clavulanic acid. Amoxicillin belongs to the penicillin class of antibiotics. This drug kills infection-causing bacteria by inhibiting the formation of their cell walls. Meanwhile, clavulanic acid prevents the bacteria from producing enzymes that can reduce amoxicillin's effectiveness. This allows amoxicillin to work more effectively. Co-amoxiclav trademarks: Betaclav 500, Clamixin, Co-Amoxiclav Dexa Medica, Coyarin, Vibranat.

Co-Amoxiclav is available in various formulations with varying ratios of amoxicillin and clavulanic acid per tablet or 5ml syrup. These include 500/125 mg (625 mg) and 875/125 mg (1000 mg) per tablet, or 125 mg/31.25 mg and 250/62.5 mg per 5ml syrup. The dosage and duration of co-amoxiclav use will be determined by the doctor based on the patient's condition and age.

Generally, the oral dose of co-amoxiclav for adults to treat bacterial infections is 625 mg three times daily or 1000 mg twice daily. For children under 6 years of age, the dose is 25 mg/3.6 mg/kg per day, divided into three doses. Co-amoxiclav is given for 5–14 days. For co-amoxiclav injectable preparations, the dosage and administration will be carried out directly by a doctor or medical staff under the supervision of a doctor at a health facility.

Treatment for carbuncles requires early administration of antibiotics and timely surgical intervention, as well as optimization of patients' underlying pre-existing co-morbidities. Reconstructive surgery might be needed later if there is a soft tissue defect following treatment. Two methods of surgical intervention are commonly used, which are saucerization and I&D. Saucerization involves wide excision and removal of the necrotic

center and surrounding unhealthy tissue until the surgical margins are viable. The wound is usually large and left to heal with secondary intention or reconstruction surgery if needed. In comparison, I&D has a smaller wound, by only removing the purulent materials in the center and the surrounding inflamed tissues are treated with antibiotics. Saucerization is more preferred as it removes all necrotic tissues in one setting. However, most of the time saucerization is done under GA; and patients with multiple underlying co-morbidities will have to bear high risks for GA. These two methods would require daily dressing and meticulous debridement of unhealthy tissues, which often cause patients a great deal of torment. Following that, some patients might also need secondary procedures sure as secondary suturing or split-thickness grafting for large or non-healing wounds.

Diabetes is a disease caused by impaired blood glucose levels. This occurs when the body does not produce enough insulin or cannot use it properly. This is characterized by the characteristic symptoms of continuous (large) urination with a sweet taste (diabetes) (Bilous & Doni, 2022). Damage to pancreatic β cells and insulin resistance due to a reduced ability of insulin to stimulate glucose utilization or a decreased response of target cells, such as muscle, tissue, and liver, to physiological insulin levels are also primary causes of diabetes. Diabetes mellitus is one of the most significant non-communicable diseases (ncds) globally and a major contributor to a poorer quality of life (Tamornpark et al., 2022).

Diabetes mellitus (DM) is a disease caused by disruption of the glucose metabolism process in the body accompanied by various metabolic disorders due to hormonal disorders, which cause various chronic complications in the eyes, kidneys, and blood vessels, accompanied by lesions on the basement membrane with characteristics of hyperglycemia (American Diabetes Association, 2023). Diabetes mellitus (DM) is a chronic metabolic disorder due to the pancreas not producing enough insulin or the body cannot use the insulin produced effectively, resulting in an increase in glucose concentration in the blood or hyperglycemia (PUSDATIN Ministry of Health of the Republic of Indonesia, 2021). According to Smeltzer & Bare (2019), diabetes mellitus is a chronic disease that causes multisystem disorders and is characterized by hyperglycemia caused by insulin deficiency or inadequate insulin action.

Diabetes Mellitus is a metabolic disease that occurs due to the interaction of various factors: genetic, immunological, environmental and lifestyle. Diabetes mellitus is a collection of symptoms that arise in a person caused by an increase in blood glucose levels due to a decrease in progressive insulin secretion due to insulin resistance. This statement is in line with the IDF (2017) which states that diabetes mellitus is a chronic condition that occurs when blood glucose levels increase because the body is unable to produce a lot of insulin hormone or lack of effective insulin function. According to the American Diabetes Association (ADA) diabetes is a very complex and chronic disease that requires continuous medical treatment with a glycemic index control strategy based on multi-risk factors.

Type 1 diabetes mellitus (DM) occurs due to autoimmune destruction of pancreatic beta cells. In this type of diabetes, there is little or no insulin secretion, as determined by low or undetectable levels of c-peptide. The first clinical manifestation of this disease is ketoacidosis. Type 1 diabetes is caused by a viral infection or immune system damage caused by an autoimmune reaction that completely destroys the insulin-producing β cells in the pancreas. Therefore, in type 1 diabetes, the pancreas cannot produce insulin. To survive, people with diabetes must be given insulin by injection. If insulin is not administered, the patient will become unconscious, also known as ketoacidotic coma or diabetic coma.

In people with this type of diabetes, hyperinsulinemia occurs, but insulin cannot transport glucose into the tissues due to insulin resistance, which is a decrease in insulin's ability to stimulate glucose uptake by peripheral tissues and inhibit glucose production by the liver. This insulin resistance (inactivation of insulin receptors due to perceived high blood levels) results in a relative insulin deficiency. This can lead to reduced insulin secretion in the presence of glucose, along with other insulin-secreting substances, causing pancreatic beta cells to become desensitized to glucose.

Type II diabetes mellitus is a condition characterized by high blood sugar levels caused by the body's cells being insensitive to insulin. This condition is called non-insulin-dependent diabetes mellitus. Women are found to be at higher risk for type II diabetes mellitus than men (Fatimah, 2021).

Type II diabetes mellitus is defined as a common metabolic disorder worldwide. This disease is caused by two main factors. First, it is caused by impaired insulin secretion by pancreatic β cells. Second, it is caused by the inability of body tissues to respond to insulin. Insulin hormone release must be balanced, ensuring proper mechanism and synthesis. Therefore, if there is an abnormality in the insulin metabolism mechanism, it will be one of the pathogenesis factors for type II diabetes mellitus. Sufferers of this disease are generally characterized by obesity, resulting in high levels of body fat, particularly accumulated in the lower abdomen. This causes adipose tissue to trigger insulin resistance through various inflammatory mechanisms, including increased free fatty acid release and reduced adipose tissue regulation (Galicia-Garcia et al., 2022).

Type II diabetes mellitus is caused by relative failure of pancreatic β cells and insulin resistance. Insulin resistance is the decreased ability of insulin to stimulate glucose uptake by peripheral tissues and to inhibit glucose production by the liver. Pancreatic β cells are unable to fully compensate for this insulin resistance, resulting in relative insulin deficiency. This inability is evident in reduced insulin secretion when stimulated by glucose, or when glucose is stimulated in combination with other insulin secretion stimulants.19 Symptoms of this type of diabetes are gradual and even asymptomatic. With a healthy lifestyle, including a balanced diet and regular exercise, patients usually recover gradually. Patients must also be able to maintain a normal body weight. However, patients in the late stages may be given insulin injections.

This type of diabetes mellitus (DM) occurs due to metabolic disorders characterized by elevated blood glucose levels due to genetic factors such as beta cell function, genetic defects in insulin action, exocrine pancreatic disease, other endocrine metabolic diseases, iatrogenic factors, viral infections, autoimmune diseases, and other genetic syndromes associated with DM. 17 This type of diabetes can be triggered by drugs or chemicals (such as those used in the treatment of HIV/AIDS or after organ transplantation).

This type of DM occurs during pregnancy, where glucose intolerance is first discovered during pregnancy, usually in the second and third trimesters. Gestational DM is associated with increased perinatal complications. Patients with gestational DM have a greater risk of developing persistent DM for 5-10 years after delivery.

According to Black & Hawks (2020), DM is a chronic, progressive disease characterized by the body's inability to metabolize carbohydrates, fats, and proteins, resulting in hyperglycemia (high blood glucose levels). From the definitions above, it can be concluded that DM is a metabolic disease when the body cannot produce enough insulin or cannot use insulin, which is characterized by the body's inability to metabolize carbohydrates, fats, and proteins, resulting in an increase in blood glucose levels, namely blood sugar exceeding 200 mg/dl and fasting blood sugar exceeding 126 mg/dl.

In diabetes, there are two main problems related to insulin: insulin resistance and impaired insulin secretion. Normally, insulin binds to specific receptors on the cell surface. As a result of insulin binding to these receptors, a series of reactions occur in glucose metabolism within the cells. Insulin resistance is accompanied by a decrease in intracellular reactions. Thus, insulin becomes ineffective in stimulating tissue uptake. Several factors are thought to play a role in the development of insulin resistance. These include genetics, age (insulin resistance tends to increase in people over 65), obesity, family history, and certain ethnic groups such as Hispanics and Native Americans (Wulandari, 2021). To overcome insulin resistance and prevent glucose buildup in the blood, an increase in the amount of insulin secreted must occur. In patients with impaired glucose tolerance, this condition occurs due to excessive insulin secretion, which maintains glucose levels at normal or slightly elevated levels.

However, if beta cells are unable to keep up with the increased insulin demand, glucose levels will rise, leading to diabetes (Wulandari, 2018). Despite the impaired insulin

secretion characteristic of diabetes, adequate insulin is still present to prevent fat breakdown and the associated ketone body production. Therefore, diabetic ketoacidosis is rare in diabetes. If diabetes is uncontrolled, it can lead to another acute problem called hyperglycemic hyperosmolar nonketotic syndrome (HHNS) (Wulandari, 2021).

A picture of gas gangrene was found in the superficial subcutaneous to the muscle which was interpreted as a sinus tract. Histopathological examination found fibroadipose tissue with abscess formation and extensive necrosis (Akram et al., 2022). The most common culture results found were *Staphylococcus aureus* bacteria at 54% (Balintescu et al., 2022). Among the *Staphylococcus aureus* isolates, 46% were S. Aureus which were resistant to methicillin. Other important pathogens were beta hemolytic streptococcus and gram-negative bacteria. The recommended first-line antibiotic is amoxicillin/clavulanate 1 gram every 8 hours while waiting for culture results (Balintescu et al., 2022).

In patients at risk for MRSA including personal or household contacts with MRSA infection or colonization in the past 12 months, with prior antibiotic use for 5 days in the past 90 days or who do not respond to first-line therapy, one of the oral antibiotics is added, such as doxycycline 100 mg every 12 hours, trimethoprim and sulfamethoxazole 160/800 mg every 12 hours, or clindamycin 300 mg every 8 hours in patients who are allergic to beta-lactams. Antibiotics are given for 5 days but can be extended to 10 days if there is no improvement in clinical symptoms (Gheisari et al., 2021).

Treatment for carbuncles is with antibiotics and early surgical procedures. A recent meta-analysis review showed that mortality was significantly lower in patients who were operated on within six hours of hospital admission compared to when treatment was delayed for more than 6 hours. Surgery within six hours resulted in a mortality rate of 19% compared to 32% when surgery was delayed for more than six hours (Gheisari et al., 2021). Antibiotics were started immediately after sampling for smears and cultures, and the patient was sent to the operating room for surgical debridement to evacuate all pus and necrotic tissue (Akram et al., 2022).

The two most common surgical methods are saucerization and incisional drainage. Saucerization involves a wide incision, removing the center of necrotic tissue and surrounding cellulite to the extent of healthy tissue. The resulting wound is large and requires skin grafting. In comparison, incisional drainage produces a smaller wound by simply removing the purulent tissue in the center while the surrounding inflammatory tissue is treated with antibiotics.

Saucerization is more recommended because it can remove necrotic tissue in one go and shorten the length of hospitalization. However, most Saucerization is performed under general anesthesia and patients with multiple underlying comorbidities should avoid the high risk of general anesthesia as much as possible. In addition, wound healing takes longer than the Incision drainage method.

In the incision drainage method, the wound can heal within 8 weeks after surgery. Both methods require careful daily dressing changes and debridement of necrotic tissue. Surgical debridement sessions are performed for 7 days to remove all necrotic tissue. After ensuring that the spread of necrotic tissue has stopped, wound treatment with vacuum and negative pressure is given for 12 days until granulation tissue fills the wound. Furthermore, skin grafting can be performed after tissue granulation is good (Akram et al., 2022). Some patients require a second procedure, namely split-thickness grafting for extensive wounds that do not improve. However, conventional surgical therapy continued with skin grafting requires an average hospitalization of up to 21 days. Skin grafting is considered to reduce the risk of pain and bleeding due to repeated dressing changes (Akram et al., 2022). Skin grafting can accelerate surgical wound healing to 2 weeks (Ahmad & Siddiqui, 2017).

Re-exploration should be performed if within 12-24 hours after the first operation, the patient clearly shows worsening clinical local and systemic infection and with worsening laboratory parameters. Delaying re-debridement in this case may increase the incidence of acute kidney injury (Gheisari et al., 2021).

Patients with diabetes have impaired wound healing and increased susceptibility to infection that can affect the course of the disease. Although progression of carbuncles to

necrotizing soft tissue infections is rare, they still need to be evaluated. Rapidly progressive infections should be treated as necrotizing soft tissue infections (NSTI) because diabetes mellitus is the most common disease associated with NSTI at 44.5%. Diabetic patients generally experience polymicrobial infections and have worse outcomes (Gheisari et al., 2021).

Delayed diagnosis and delayed treatment of these infections increase mortality by 20% to 60% Delayed diagnosis and delayed treatment of these infections increase mortality by 20% to 60% (Ahmad & Siddiqui, 2017). Patients with NSTI usually experience severe pain disproportionate to physical findings, accompanied by swelling and erythema. The clinical picture can worsen rapidly, sometimes over several hours. The percentage of symptoms of NSTI that appear include swelling (81%), pain (79%), erythema (71%), warmth (44%), bullae (26%), skin necrosis (24%), crepitus (20%), fever (40%) and hypotension (21%). To predict the presence of NSTI, the Laboratory Risk Indicator for Necrotizing infection (LRINEC) score is proposed.

LRINEC ≥ 6 has a sensitivity of 68%, specificity of 84.8% while LRINEC ≥8 has a sensitivity of 40.8% and specificity of 94.9%. Finger test is another additional method to diagnose NSTI. It is performed under local anesthesia. A 2 cm incision is made through the deep fascia. Minimal tissue resistance to finger dissection (positive finger test), absence of bleeding, presence of necrotic tissue, cloudy and gray fluid (dish water) after incision indicates the diagnosis of NSTI (Gheisari et al., 2021). The initial empiric antibiotic regimen for NSTI should consist of broad-spectrum drugs, including anti-MRSA and anti-gram-negative coverage. Antitoxin-active antibiotics such as clindamycin should be included in the empiric antibiotic regimen.

The rapid spread of infection followed by aggressive surgical intervention is one of the challenges in wound care. Negative pressure wound therapy (NPWT) has become a common therapeutic modality for the management of various acute and chronic wounds. After all necrotic tissue is removed, NPWT helps the wound heal physiologically. Negative pressure triggers increased blood flow, improves tissue perfusion, reduces swelling, absorbs fluid and exudate, inhibits infection, and dries the wound, allowing inflammatory cells to migrate into the wound. This condition triggers accelerated granulation tissue formation by eliminating bacterial contamination and exudate.

4. Conclusions

Based on the results of therapy with the antibiotic Co-Amoxiclave 1000 mg every 8 hours orally for 10 days accompanied by incision drainage with local anesthesia lidocaine 2% with a carbuncle size of >10 cm who received treatment, 10 patients were successfully cured with outpatient care, without complications or readmissions. So it can be concluded that for the treatment of carbuncle cases in patients in the early stages, it is possible and effective to treat with oral coamoxiclav antibiotics alone, although incision and drainage must still be carried out as early as possible. Carbuncles are common infectious lesions, especially in people with diabetes. Administration of antibiotics must be accompanied by adequate hydration in patients. For hospital health workers, handling carbuncle cases in patients at an early stage, by carrying out initial treatment with oral coamoxiclav antibiotics is effective, although incision and drainage must still be carried out as early as possible.

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Author Contribution

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The author declare no conflict of interest.

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