Did Jesus Die by Suffocation?:
An Appraisal of the Evidence

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Abstract
A majority of medical and lay articles regarding crucifixion, and specifically the crucifixion of Jesus Christ, now state that suffocation was the primary cause of death from crucifixion. An in-depth analysis reveals that this theory is based on a form of torture unrelated to crucifixion and that no evidence directly linking suffocation to crucifixion has been published. Indeed, a thorough review of available ancient evidence from literature, artwork, graffiti, and modern archeology and re-enactment studies reveals no evidence in favor of suffocation and much evidence against suffocation as the cause of death in typically-portrayed crucifixions, and particularly for the crucifixion of Jesus Christ. Researchers are encouraged to look elsewhere for the most likely cause or causes of death from crucifixion. It may be time to abandon the idea that suffocation was the primary cause of death in crucifixion.

Keywords
Crucifixion, suffocation, asphyxiation, death of Christ, pathophysiology

Introduction
In the Summa Theologiae, Saint Thomas Aquinas answered many disputed questions by presenting the best possible arguments of those who disagreed with him before he explained his own conclusions. This article attempts to do the same. The first part of this article reviews the reasons that many authors believe that Jesus’ death on the cross was primarily or substantially due to suffocation. In the latter part, evidence against the suffocation theory is presented.

Proposed Causes of Death in Crucifixion
Since the Flemish humanist philosopher Justus Lipsius released his illustrated three-volume De Cruce in 1593, researchers have sought to determine precisely how Jesus died (Lipsius 1593/94). William Stroud was the first known physician to propose a medical theory of the cause of Jesus’ death in 1847 when he declared that

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“every other explanation hitherto offered has been shown to be untenable, the cause now assigned for the death of Christ, namely, rupture of the HEART FROM AGONY OF MIND…” [emphasis in original] (Stroud 1847, 156).

Besides cardiac rupture, other causes of death from crucifixion have been proposed: heart failure, traumatic and hypovolemic shock, syncope, acidosis, asphyxiation, arrhythmia, pulmonary embolism (Maslen and Mitchell 2006), suspension trauma (Bishop and Church 2006), disseminated intravascular coagulopathy (Bergeron 2012), or a combination of these.

Determining a cause of death common to all crucifixions is likely impossible because victims could be crucified in multiple positions. Two contemporaries of Jesus Christ wrote:

“I see crosses there, not just of one kind but made differently by different individuals: some individuals suspended their victims with heads inverted toward the ground; some drove a stake (stipes) through their excretory organs/genitals; others stretched out their arms on a patibulum; I see racks, I see scourges, and separate instruments for separate members and joints, and I see death.” (Seneca, Dialogues 6.20.3).

“The soldiers out of rage and hatred amused themselves by nailing their prisoners in different postures; and so great was their number, that space could not be found for the crosses nor crosses for the bodies.” (Josephus, War of the Jews 5.449-451)

However, there likely was a common method of crucifixion that could be varied (Cook 2019). We know from the Gospels that Jesus was not crucified upside down and did not have a stake driven through his groin.

A Recent Consensus?

Nevertheless, recent authors have stated that asphyxiation has reached consensus status among medical authors as the cause of death in crucifixion (Bordes et al. 2020; Habermas, Kopel, and Shaw 2021; Habermas and Shaw 2021; Ingham and Duhig 2022). For instance

“This article surveys a broad range of medical specialist views regarding Jesus’ experience on the cross, concluding that asphyxiation or asphyxiation-dominant theories have emerged as the consensus position regarding the cause of Jesus’ death” (Habermas and Shaw 2021)

That article simply tallies results of a literature search that found that in 40 articles and books written by physicians proposing a specific cause of death in crucifixion, 28 (70%) stated that asphyxiation was the primary cause (Habermas, Kopel, and Shaw 2021, Table 1). A recent find of a 2nd century A.D. skeleton in England with a nail through a heel bone described as belonging to a crucifixion victim stated that death in crucifixion “was usually due to asphyxia as the chest muscles became exhausted…” (Ingham and Duhig 2022, 28)

Thankfully, Habermas and Shaw see the fallacy in using only numbers as a guide when they write

“So the sheer numbers of scholars just mentioned in our study above hardly prove that asphyxiation must be the only cause of death by crucifixion because that would not follow. If this fairly significant majority of medical views arises from carefully derived medical reasons based on the historical descriptions, both past as well as modern, then a general direction in favor of asphyxiation still may indicate the probability here regarding most cases including the instance of Jesus, as well. The majority scholarly agreement in numbers may well be significant.” (Habermas and Shaw 2021, 16)

This article aims to do just what Habermas and Shaw recognize as essential: to carefully examine historical descriptions of crucifixion and combine that information with modern evidence to evaluate the asphyxiation theory as a significant cause of death from crucifixion.

Calls to Do Better

Two papers have rightly called out those of us writing about the crucifixion of Jesus to point
out common shortcomings in addressing a subject at the same time sacred, historical, and medical (Maslen and Mitchell 2006; van Wingerden 2020). While pointing out that Crucifixion reenactment studies have “only limited relevance to genuine cases” (Maslen and Mitchell 2006, 187), we believe that “limited” implies “some” relevance, which we will point out. Most articles do not refer to historical data from the original languages (particularly Greek and Latin) and merely quote other modern authors’ use of ancient texts (Maslen and Mitchell 2006), and in most cases there is “little interaction between the medical and historical branches of academic research” (van Wingerden 2020). This lack of communication leads to medical articles that make claims contrary to the historical record.

**Our Modest Goal**

In this paper, we propose to demonstrate that death by asphyxiation could not be the common cause of death in crucifixion victims, and specifically in the case of Jesus Christ, based on evidence from history (literature, graffiti, artwork) and science (archeology, reenactment studies). We agree with van Wingerden:

> “Medical studies may thus benefit more from the insights of historical studies, which may lead to other insights into the possible causes of death by crucifixion.” (van Wingerden 2020, 566)

We do not aim to demonstrate at this time what we believe to be the most likely cause of Jesus’ death based on the evidence; the goal of this paper is to demonstrate the untenability of the asphyxiation theory.

**Origin and Growth of the Asphyxiation Theory**

The first author to propose that Jesus—and other crucifixion victims—died primarily due to asphyxiation was the French physician Dr. AA LeBec (LeBec 1925). He conceived the idea that the “raised position of the arms” of a crucifixion victim would expand the chest to a position of inspiration and relatively immobilize the sides of the chest and “greatly hinder breathing out”. His original 1923 French article was translated and published in English in 1925 and stated:

> “The position of the raised arms occasioned painful respiratory troubles. The ribs were immobilized, and the movements necessary for expiration became thus very difficult. The viscera in the abdomen became displaced and paralyzed, which hindered the movement of inspiration. The crucified thus had a sensation of progressive suffocation, from which he could not gain the slightest relief. The heart was gravely hindered in its functions. The arms being raised, it had double work to send the blood to the hands…As the oxygenation of the blood in the lungs grew worse and worse, it became surcharged with carbonic acid, which caused an excitation of the muscular fibers, and in consequence a kind of tetanic condition of the body which would persist until exhaustion and paralysis supervened.” p. 130

LeBec proposed that victims would shift their weight from hands to feet repeatedly to reduce the pain on either location, but he did not paint a picture of movement to improve breathing as later authors would (Barbet 1953; Edwards, Gabel, Hosmer 1986). He wrote that “death was slow” and that “vigorous criminals sometimes lived 3 days on the cross” and that victims died because “the cardiac muscle had been taxed beyond its strength, and our Lord succumbed to syncope” (Barbet 1953, 131). It’s unclear how suffocation could require 3 days to cause death.

In 1936, Dr. Rudolph Hynek of Prague published a book in English that stated that “the direct cause of the death of Christ was suffocation” (Hynek 1936, 85). Hynek mentioned a form of torture he had seen in 1914 (Barbet 1953, 75) inflicted by members of the Austro-German Army during WWI variously called *anbinden* (tether) (Hynek 1936) or *aufbinden* (untie, what victims purportedly yelled in German) (Hynek 1951). *Anbinden* involved
tying the guilty soldier in such ways that he was compelled to stand on the tips of his toes. In this forced posture the extremely strained muscles soon passed into spasmodic contractions, causing excruciating pains. For that reason it was not permitted that the ordeal last more than five or ten minutes. (Hynek 1936, 80)

In his later book, he describes the position of aufbinden in more detail:

“Under this punishment the culprit’s wrists were crossed and bound behind his back (emphasis added), and he was then suspended by them in such a way that only his toes touched the ground. This caused him intense pain and exhausted him so greatly that he had to be taken down after 10 min at the most or his health would have suffered severely.” (Hynek 1951, 60)

This description of aufbinden differs from the description of Barbet where

“aufbinden...consists of hanging the condemned man by his two hands from a post. The tips of his two feet can scarcely touch the ground. The whole weight of his body, and this is the important thing, drags on his two hands which are fixed above him (emphasis added).” (Barbet 1953, 75)

Dr. Barbet’s description seems to suggest a position where someone merely raises their hands above their head and has them tied to a post, almost akin to the position children assume when hanging on to monkey bars on a playground. This sounds like the same position that Dr. Mödder used for his experiments (see below).

Thus, we have two different positions for this tethering punishment which would certainly cause distinct sets of medical problems. In Barbet’s description, the hands were directly overhead either tied together or separated.

Barbet’s appendix includes a description written by eyewitnesses to aufbinden as performed at Auschwitz during World War II (Barbet 1953, 174). Victims were tied with all their body weight supported by their hands. In a “short time” breathing became intolerable, and they would pull up their bodies as doing a pull-up. This seemed to relieve the breathing discomfort. Weights would sometimes be applied to the feet to prevent the men from pulling up. Without weights, asphyxia set in after about an hour; with weights, asphyxia and death occurred within three to 4 minutes.

Hynek said that in aufbinden/anbinden the lungs would fill with air that could not be expelled and the weaker muscles of expiration would contract. Each man looked “as if he was being strangled” or was “emphysematous in a bad attack of asthma.” The thoracic frame swelled maximally while the epigastric hollow became extremely concave. The skin became red and then violet and profuse sweat poured from the body. Muscles gradually became fixed in contraction starting from the forearms and arms and progressing to the lower limbs, trunk, pectorals, neck muscles, and diaphragm. The state of the body was compared to that in tetanus, and after death, bodies were rigid. While Hynek reported that men had to be cut down within 10 min to survive, the Dachau prisoners said death took about 3 hours when the hands were tied together and longer when the hands were separated.

Mödder’s Studies

Doctor Hermann Mödder, an Austrian Radiologist of Cologne performed experiments on medical students to examine the asphyxiation theory by re-enacting anbinden/aufbinden in the manner described by Barbet and the Auschwitz eyewitnesses. In the beginning of his 1948 article, he refers to Hynek’s earlier work and believed that the outstretched arms on the cross would lead to muscle spasms and ischemic cramps and eventually fixing the lungs in a position of inhalation (Mödder 1948). He wrote that the arch of the diaphragm would flatten and that the diaphragm would be the only method for getting air out of the lungs. He proposed that poorer
oxygenation of blood would only intensify muscle contraction.

Hynek also described research on subjects whose arms were extended above their heads with their feet barely touching the ground and did x-rays to show that the diaphragm did indeed flatten out and sink (Hynek 1951, 64-65). He also read into the image on the Shroud of Turin “desperate efforts to breathe” (Hynek 1951, 62) in the rigid appearance of the great pectoral muscles which likely represent rigor mortis. Hynek’s mention of “facies ecchymotica” are also mentioned as evidence of suffocation, however, ecchymoses on the face can be caused by many other means including this torture and falls.

Mödder suspended students from a horizontal bar using cloth bands around their wrists with their hands separated by one meter (Mödder 1948). (Note that this is a different position than anbinden where the wrists were tied behind the lower back and then pulled vertically behind and above the victim’s head.) Within 6 minutes, student vital capacities decreased 70% (from a mean of 5.2 L to 1.5 L) while blood pressure dropped and pulse rose. At 12 min, respiration became purely diaphragmatic and disturbed consciousness ensued. If able to rest on their feet for even 20 s, the cardiovascular changes improved significantly and breathing became easier, if not normal.

Barbet theorized that reduced oxygenation of blood led to accumulation of carbonic acid in muscles, progressive muscular contraction, and finally “tetanisation” with the muscles fixed in a contracted position (Barbet 1953, 76). In this state, victims would eventually suffocate because of the inability to exchange air, because their lungs would be in a fixed state of full inspiration. He stated that “All the crucified died asphyxiated” (Barbet 1953, 74).

This theory received strong support and wide dissemination in a 1986 JAMA article entitled On the Physical Death of Jesus Christ by cardiac pathologist William Edwards and colleagues (Edwards, Gabel, and Hosmer 1986). Interestingly, the Edwards article quotes three sources, including Barbet’s book and a short letter (DePasquale and Burch 1963) to support the asphyxiation theory. Neither of these sources provide references to support the theory other than Barbet’s quoting of LeBec, Mödder, and Hynek. The third reference (Lumpkin 1978) refers only to Barbet’s book when asserting the theory of death due to asphyxiation.

Therefore, it appears that the justification for the theory of death by suffocation began with an idea of LeBec first published in 1923 with no support from history or reenactment studies (LeBec 1925). Hynek based the idea on possible similarities to a tethering torture called anbinden or aufbinden. Studies on hanging medical students seem to corroborate the challenges of hanging by the wrists, but no evidence is presented to demonstrate that this occurs with crucifixion.

Other medical professionals have carried on the promotion of the asphyxiation theory to the present day without proposing evidence to support it (Retief and Cilliers 2003; Papaloucas 2004; Bordes et al. 2020; Habermas, Kopel, and Shaw 2021).

The Leap From Wrist Hanging to Crucifixion

Barbet applied LeBec’s theory and the observations of Hynek and the Dachau prisoners to crucifixion. He used the Shroud of Turin for determining the position of Jesus on the Cross, and he determined this based on the flows of blood seen on the left dorsal wrist in the Shroud. Barbet assumed that these blood flows were vertical when Jesus was hanging on the cross, and therefore, he estimated that the angle Jesus’ upper extremities made with the vertical was about 65° (Barbet 1953, pp. 95-96). He believed that crucifixion victims were nailed with their arms outstretched horizontally. When placed on the upright post (stipes), he assumed that as the body sagged with gravity, this would cause the arms to lengthen about two inches and form a 65° angle with the vertical stipes.

Barbet believed that the two blood flows from the left wrist separated by an angle of
about five degrees was formed when crucifixion victims pushed themselves up to bring their elbows closer to their sides and thus more effectively exhale. He saw this effort as the best thing that crucifixion victims could do to approximate what anbinden victims achieved by pulling their bodies up. However, it is unclear how anbinden victims who had their arms tied behind them (instead of freely hanging above them like Modder’s subjects) could pull themselves up at all.

Barbet posited that eventually, all muscles would contract and cramp so that expiration was no longer possible, and being unable to empty their lungs, victims would die of asphyxia once they could no longer lift themselves by extending their knees (straightening their legs from the “sagging” position). (Barbet 1953, 96)

DePasquale and Burch (1963) wrote it “appears likely that the mechanism of death in crucifixion was suffocation” even though they state that Jesus’ cross had a crude seat called a sedile which would presumably have taken tension off the wrists, arms, and pectoral muscles. Notably, this letter had no references to support their statements. Like Barbet, they stated that breaking the legs of crucifixion victims would lead to swift death by suffocation since victims would no longer be able to push up to adequately exhale.

Edwards, Gabel, and Hosmer (1986) ushered in a more intense dialogue in the medical literature about the asphyxiation theory and wrote that

“The major pathophysiologic effect of crucifixion was an interference with normal respirations. Accordingly, death resulted primarily from hypovolemic shock and exhaustion asphyxia.” (p. 1455)

The Edwards article continued promoting the idea above that crucifixion interfered with normal exhalation since the weight of the body pulling down on stretched arms and shoulders would fix the intercostal muscles in a position of inspiration and prevent passive exhalation. Therefore, breathing would have been shallow and primarily diaphragmatic and it would be “likely,” although no evidence is given, that respiration in that condition would be inadequate and lead to hypercarbia-induced fatigue followed by muscle cramps and tetanic contractions:

“Adequate exhalation required lifting the body by pushing up on the feet and by flexing the elbows and adducting the shoulders and would produce searing pain. Furthermore, flexion of the elbows would cause rotation of the wrists about the iron nails and cause fiery pain along the damaged median nerves. Lifting of the body would also painfully scrape the scourged back against the rough wooden stipes. Muscle cramps and paresthesias of the outstretched and uplifted arms would add to the discomfort. As a result, each respiratory effort would become agonizing and tiring and lead eventually to asphyxia.” (Edwards, Gabel, and Hosmer 1986)

The authors describe the rising and descending motions necessary to continue exhalation in which the weight is borne on the nail(s) in the feet, the wrists twist about their nails, the elbows flex, and the back scrapes along the stipes of the cross. Based on Zugibe’s reenactment experiments, the subjects’ bodies never scraped against the cross since they sagged forward (Zugibe 2005). Also, even if victims had to push up only once a minute to stay alive, that would required nearly 2000 such motions in a 24-h period. They list exhaustion asphyxia as one of two prominent causes of death by crucifixion, the other being hypovolemic shock. Other factors contributing to death included dehydration, stress-induced arrhythmias, and congestive heart failure (Edwards, Gabel, and Hosmer 1986).

Assumptions of Asphyxiation Theory

There are five assumptions of the asphyxiation theory to consider when appraising evidence for or against it. First, explanations of death by suffocation on the cross generally assume that
the arms of the crucified victim were significantly above the horizontal position. Second, and due to a position where the wrists are above the shoulders and head, most of the body weight of a crucified victim was borne on the wrists, not the feet.

Third, theories propose that progressive suffocation in such a position was due to a limitation of the ability of expiratory muscles to contract and empty the lungs of air. Fourth, victims would have trouble breathing that would be evident to onlookers in their attempts to breathe and speak. Finally, in order to exhale air and prevent a build-up of carbon dioxide, crucifixion victims would have to repeatedly push themselves up on the nails in their feet, bring their elbows into their sides, and thereby compress their lungs via rib movement. Inspiration would occur passively when the body was allowed to slump down into a resting position.

What Was Jesus Position on the Cross?

Since there is a stark difference in the position of someone being crucified and a person being hung by the wrists, Maslen and Mitchell correctly asserted

“It is quite likely that different individuals died from different physiological causes, and we would expect that the orientation in which they were crucified would be crucial in this respect.”

(Maslen and Mitchell 2006, 188)

Since the position of the arms and body on the cross are critical to the theory of asphyxiation, we find it of great import to determine from the historical record the most likely position Jesus assumed on his cross.

From ancient literature referring to victims first being affixed to the crossbar (patibulum in Latin or stauros, σταυρός in Greek), we have evidence that the arms were stretched out horizontally on the crossbar. The Latin word for the crossbar, patibulum, comes from a verb meaning “to stretch out” (Dionysius of Halicarnassus, Roman Antiquities, 7.69.2.; Paolo Gatti, “Patibulum,” Thesaurus Linguae Latinae, translation as in Cook 2019, 16; Plautus, Miles Gloriosus, 359–60)

Based on John’s Gospel (20:25), we know nails were used in his hands. Not only is it reasonable to conclude that his feet would be affixed in a similar fashion, nailing is also supported by archaeological findings. Nails have been found through the feet of two presumed crucifixion victims: a first century Jerusalem man’s right calcaneus from lateral to medial (Zias and Sekeles 1985) and one pounded through a second century British man’s right calcaneus also inserted from lateral to medial (Ingham and Duhig 2022).

As the last known Roman empire crucifixions took place at least as late as 310 A.D. (Cook 2019, 214) or 334 A.D. (Cook 2019, 404), images of crucifixion made before this time shed light on the position of crucified individuals.

A graffito of a crucified woman named Alkimilla found in Puteoli near modern Naples, Italy dates to the reign of Trajan or Hadrian (98-138 A.D.) (Cook 2019, 204) and may well represent the oldest known image of crucifixion.

A graffito of a crucified man called Alexamenos (depicted with the head of an ass) on the Palatine Hill of Rome was likely formed in the 3rd century (Harley-McGowan 2018).

Finally, a gemstone from the late 2nd to 3rd century depicts Jesus as crucified (Harley-McGowan 2018).

From these three images, we see that arms are relatively horizontal with the wrists affixed to the cross-bar at a level slightly higher than the shoulders. The Alkimilla graffito shows the knees out to the sides and the heels affixed to the front of the cross, while the other two images show feet turned out but away from the stipes (upright post). In none of these images contemporary to Roman era crucifixion are the bodies sagging on the cross.

It is therefore reasonable to assume that Jesus’ arms were stretched out tightly on the patibulum, he was affixed with nails through the wrists, and that when placed on the upright stipes, his feet were attached with nails.
through the calcaneus bones and affixed to the sides (straddling) or front (knees turned out) of the upright stipes. This position seems quite different from those proposed in anbinden/aufbinden victims.

Descriptions of Those Crucified

Ancient writers left some descriptions of victims while on a cross. The Roman historian Justin (Marcus Iunianius Iustinus) wrote about the crucifixion of the Carthaginian General Bomilcar for treason after he lost a battle and tried to escape to the winning side:

“But Bomilcar with so great resolution endured this cruelty of the Citizens, that he declaimed against the wickedness of the Carthaginians from the height of the Cross, as from the height of a judgment seat … After he had roared out (emphasis added) this in a great assembly of the people, he expired…” (Iustinus Epit. 22.7.9.)

How could someone who is suffocating, even slowly, roar out to be heard by an assembly of people?

Seneca the Younger gives more descriptions of crucifixion victims than perhaps any other ancient writer. He wrote in the 1st century A.D.

“But these others who bring upon themselves their own punishment are stretched upon as many crosses as they had desires. Yet they are slanderous and witty in heaping insult on others. I might believe that they were free to do so, did not some of them spit [emphasis added] upon spectators from their own cross!” - (Sen. Dial. 7.19.3, trans. of Basore, Seneca 2.149. in Cook 2019, 98)

“Nails pierce his skin, and wherever he rests his weared body he lies upon a wound; his eyes are stark in eternal sleeplessness.” (Sen. Dial. 1.3.9-10 in Cook 2019, 95).

“There he is, praying for that which, if it had befallen him, would be the most pitiable thing in the world! And seeking a postponement of suffering, as if he were asking for life! I should deem him most despicable had he wished to live up to the very time of crucifixion: “Nay,” he cries, “you may weaken my body if you will only leave the breath [emphasis added] of life in my battered and ineffective carcass!” “Maim me if you will, but allow me, misshapen and deformed as I may be, just a little more time in the world! You may nail me up and set my seat upon the piercing cross!”

Is it of such value to press on one’s own wound and hang stretched out on a patibulum, that he might put off what is the best in evil circumstances, the end of punishment? Is it of such value to have breath so that I may breathe my last? (emphasis added)” (Seneca. Ep. 101.1, 10. in Cook 2019, 100).

He asks for the climax of suffering, and – what is still harder to bear – prolongation and extension of suffering; and what does he gain thereby? Merely the boon of a longer existence. But what sort of life is a lingering death? Can anyone be found who would prefer wasting away in pain, dying limb by limb, or letting out his life drop by drop, rather than expiring once for all? Can any man be found willing to be fastened to the accursed tree, long sickly, already deformed, swelling with ugly tumors on chest and shoulders, and draw the breath of life amid long-drawn-out agony [emphasis added]? I think he would have many excuses for dying even before mounting the cross! (Sen. Ep. 101.13-14 in Cook 2019, 102).

In these writings of Seneca the Younger, and in a review of Cook’s thorough cataloging of virtually all known descriptions of crucified individuals, we see breath and breathing spoken of multiple times. Yet never once is difficulty in breathing mentioned. Nor is
movement of victims in a rhythmic up-and-down fashion noted, as would be expected of at least some victims if the asphyxiation theory is correct. On the other hand, victims are seen to speak, heap insult, roar, and even spit on those below them (Cook 2019, 428-429).

**Reenactment Studies**

While it is true that crucifixion reenactment studies have “limited relevance to genuine cases” of crucifixion (Maslen and Mitchell 2006) and that they are open to “many criticisms” (Habermas, Kopel, and Shaw 2021), “limited” relevance does not mean “no” relevance.

These experiments can teach us something. For instance, if a healthy volunteer in an air-conditioned room who was strapped (instead of nailed) to a cross, who had not been tortured, starved, and dehydrated, and who knew he was not destined to die on it experienced certain types of discomfort, then it is exceedingly likely that an actual crucifixion victim would have experienced that discomfort—and more. Also, if a healthy volunteer was not able to perform a maneuver ascribed to crucifixion victims, then it is exceedingly unlikely that an actual crucifixion victim in a poorer state of health and strength would have been able to perform that maneuver.

**Dr. Frederick Zugibe’s Studies (Zugibe 1989b; Zugibe 2005)**

After being strapped to their crosses with leather belts on the wrists and feet, the men in Zugibe’s experiments could tolerate 5-45 min of suspension until they requested release due to painful cramping of the shoulders, arms, and hands - trouble breathing was never the reason that a volunteer asked to be released from the cross; painful muscle cramps was always the reason. The volunteers’ arms were at an angle of 15-25° above horizontal (65-75° from vertical) as recommended by Barbet. None experienced breathing difficulty either subjectively or objectively, even though by 10-20 minutes the subjects’ chests felt rigid and their legs cramped. While they did not and could not push themselves up - even once - they did arch their backs to relieve cramps, and at this time their shoulders and scalps touched the cross. At no other time did their backs touch the cross; in other words, victims sagged forward and their backs did not scrape against the stipes.

Even when subjects were tested without their feet attached (hanging from the two wrists only to more nearly simulate anbinden/aufbinden and the experiments of Mödder), they experienced no difficulty breathing. (Zugibe 2005, 101-122). The limiting factor enduring this position was shoulder pain, not breathing difficulty.

At no time did any volunteer desire to push up on his feet. When volunteers were physically pushed up on the cross, since they could not do it themselves, their wrist angle with the cross did not change as predicted by Barbet (Zugibe 2005, 117)

Zugibe also measured FIVC, and in his subjects, it decreased somewhat after 2–4 min, and then remained constant. The blood lactate levels increased to 3.5 times normal after 15 min, and the ensuing acidosis of the blood stimulated subjects to breathe more rapidly to exhale the acid as carbon dioxide.

Zugibe also reported pulse oximetry readings at all times ranging from 97 to 99.5%. The respiratory quotient increased, as expected (more carbon dioxide was breathed out over time due to increased muscle activity). Volunteers hyperventilated for the first 6 minutes, reached 2–3 times the normal respiratory rate and stabilized at that rate. In poorly-conditioned individuals, the heart rate jumped as high as 175 beats per minute.

**Dr. David Ball’s Studies (Ball 2008)**

Ball admitted that his experiments of healthy subjects (who had not been scourged, starved, dehydrated, and condemned to death) could not rule out asphyxiation playing a major role in death by crucifixion. Nevertheless he wrote
I have watched many volunteers hang on the cross. They never seem to have any significant respiratory difficulty [emphasis added]. More to the point, they never engage in the rhythmical up and down movement Dr. Barbet describes as essential for efficient respiration to occur. (Ball 2008, 70)

The longest any of Ball’s volunteers could tolerate being on the cross was 31 minutes (always limited by muscle cramps), with an average of 8-12 minutes. Ball rightly wondered if respiratory efficiency might be a function of time, that is, might difficulty breathing only begin after a longer period of time than the 45 minutes maximum that one of Zugibe’s volunteer stayed on the cross?

Ball placed his 18–35 year-old male volunteers on a cross in one of two positions: 10 with arms extended horizontally and 10 with arms extended vertically. In each position, the feet were supported. It made sense to test the two extreme arm positions possible for crucifixion; any difference based on arm angle with the cross would be maximized compared to Zugibe’s experiments where the arms were all 15–25° from horizontal as recommended by Barbet.

One of Ball’s findings confirmed one of Zugibe’s findings regarding pain. Those with arms stretched horizontally could tolerate an average of 8.1 minutes on the cross while those with arms vertically overhead could tolerate an average of 12.6 minutes on the cross before pain became unbearable. Since horizontal placement was more painful, it would be reasonable that the Romans discovered this and were more likely to use this position (and this fits with the ancient images made during the times that crucifixions were performed).

While Ball states that he “measured volumes and pressures” and “gathered data without knowing what I would find,” this breaks a cardinal tenet of research in which a specific hypothesis or multiple hypotheses are tested. When many types of data are collected without a hypothesis, chances are good that something will show a statistically significant difference, even if by chance!

Ball does not mention the different types of spirometry data he collected; he only reports one of the variables, the FIVC (Forced Inspiratory Vital Capacity). This measures how much volume one can inhale after forcing as much air out of the lungs as possible. Pulmonologists do not often use this test since it is not as clinically relevant as measures such as FEV1 or FVC. A reduction in FIVC can demonstrate a reduction in lung function due to neuromuscular fatigue (as the volunteers clearly experienced) as well as extra-thoracic limitations on flow such as vocal cord dysfunction or tracheal obstruction such as a tumor, retained secretions, or bronchospasm. Though both retained secretions and bronchospasm may have been present, it is unlikely that these would be life-limiting or mortality-inducing events in the context of the physiologic stress and anatomic trauma experienced during crucifixion. The Gospel narratives do not suggest that Jesus had any form of underlying chronic respiratory disorder that was exacerbated; quite the contrary, he is described as walking great distances and ascending mounts without any indication of difficulty.

As for the FIVC results, those with arms vertical experienced a 7.0% reduction (4.89 to 4.55 L) over 12.6 minutes compared to a 2.3% reduction (4.81–4.70 L) over 8.1 minutes for those with arms horizontal (historically the more likely crucifixion position). Because no statistical tests were applied, and because it is not known if the results for the “vertical volunteers” would have been equivalent at 8.1 minutes and only worsened over the followed 4.5 minutes (to the tested average of 12.6 minutes), data comparability is unclear.

Ball asked a good question (does increased time on the cross contribute to increased difficulty breathing?). Unfortunately, his study design, statistical evaluation, and reporting do not allow the drawing of any meaningful conclusions. His reported results neither confirm nor deny the possibility of asphyxiation playing a role in the sufferings or death by crucifixion.

It is reasonable to believe that if a victim’s FIVC continued to decline as it had for the first
8 minutes, that breathing could be significantly compromised by 3 hours (Christ’s time on the cross). Someone could not survive on the cross for 12–24 hours or more if FIVC continued to drop at that rate. However, note that FIVC dropped for 2–4 minutes in Zugibe’s studies and then stabilized.

**Reenactments Summary**

Neither Zugibe’s nor Ball’s subjects experienced difficulty breathing. No leg edema or oxygen desaturation was noted. No subject could push himself up and bring his elbows in to his sides, a requirement of the asphyxiation theory.

**Duration of Time on the Cross**

If the asphyxiation theory is true, then one must believe that victims were regularly pushing themselves up on the cross to augment their breathing. For how long would they have needed to do that?

In 1st century A.D., Philo Judaeus (a.k.a Philo of Alexandria) thought that crucifixion victims simply died of starvation:

“For death follows the scarcity of food; and the one who did wrong in these matters appropriately dies by being suspended, suffering the same evil that he arranged (for others), because he suspended and tortured the starved man with hunger.” (Philo Ios [On Joseph] 156 in Cook 2019, 236).

Writing in the late first century A.D., Josephus mentions the story of three friends he finds crucified. After Jerusalem was captured in 70, Titus sent Josephus to Tekoa. Hours must have elapsed on the trip to Titus and back to his crucified friends, yet one of them survived.

“Once more, when I was sent by Titus Caesar with Cerealius and a thousand horses to a village called Tekoa, to prospect whether it was a suitable place for an entrenched camp, and on my return saw many prisoners who had been crucified, and recognized three of my acquaintances among them, I was cut to the heart and came and told Titus with tears what I had seen. He gave orders immediately that they should be taken down and receive the most careful treatment. Two of them died in the physicians’ hands; the third survived.” - (Josephus Vita 420-421. Trans. of Josephus, I, The Life. Against Apion, LCL, ed. and trans. H. St. J. Thackeray, Cambridge, MA/London 1926, 155.)

Origen of Alexandria was an early theologian who died in the middle of the third century A.D. and wrote

“Pilate … fearing the tumult of the entire mob, did not command, according to the Romans’ custom for those who are crucified, that Jesus be pierced underneath the arms of his body – which those do occasionally who sentence individuals that have been found guilty of serious crimes (since accordingly they who are not pierced after being nailed endure great agony, but live on in extreme pain, sometimes indeed an entire night and even a whole day after) (emphasis added). - (Origen Commentaries on Matthew in Cook 2019, 112).

The early Church Historian Eusebius of Caesarea was born between 260–265 A.D. when crucifixion was still practiced in the Roman empire, so it is likely he either witnessed or spoke with people who witnessed crucifixion. He wrote in his *Church History*

“… others with good courage stretched forth their heads to them that cut them off, or died in the mist of their tortures, or perished with hunger; others again were crucified, some as malefactors usually are, and some, even more brutally, were nailed in the opposite manner, head-downwards, and kept alive until they should perish of hunger (emphasis added)on the gibbet (mast/cross). (Eusebius H.E. 8.8.1 in Cook 2019, 8)

In the early fifth century, Saint Augustine of Hippo wrote about the slow death of crucifixion:

“For the crucified, hanging on the tree, nailed to the wood, were killed by a slow lingering death.
To be crucified was not merely to be put to death; for the victim lived long on the cross, not because longer life was chosen, but because death itself was stretched out that the pain might not be too quickly ended.” (Saint Augustine, Tractates on John, 36.4.)

Since the asphyxiation theory requires that suffocation would rapidly lead to death if victims did not repeatedly raise themselves on their feet, and if even healthy reenactment subjects could not even do it once under less strenuous conditions, how can we believe that tortured victims could do it the hundreds or thousands of times necessary to remain alive for a day or longer until starvation ensued?

**Reconciling the Evidence**

When considering the asphyxiation theory, no positive evidence has been put forth to support it either from literary history (descriptions of suffocating, wheezing, or rising-and-falling victims) or reenactment studies. Although this does not disprove the theory, it does not prove it either.

In light of the evidence above, how can it be reconciled with the requirements of the asphyxiation theory?

*Requirement 1 - Crucifixion victims’ arms were above horizontal*

Based on ancient images contemporary with active crucifixion, including one representing Christ on the cross, the arms of crucifixion victims were probably slightly above horizontal, but certainly nowhere near vertical as in the tethering torture of anbinden/aufbinden.

*Requirement 2 - Limitation of expiratory muscle activity would lead to progressive suffocation.*

This is theoretically and physiologically plausible. We possess anecdotal evidence from those who witnessed the wrist hanging torture of WWI and WWII and the report of studies on wrist hanging by Dr. Mödder. Hynek and Mödder’s comments about the swelling of the thoracic foramen and extreme concavity of the epigastric hollow do support tenting of the diaphragm and reduced ability to exhale. They describe a disruption of normal chest wall mechanics of the thoracic cage, including the ability of the chest to fully recoil. This would prevent the diaphragm from returning to its normal position and thus hinder normal expiration, as is seen in advanced COPD patients with a hyperinflated phenotype. This would indeed lead to air trapping, carbon dioxide retention, and respiratory acidosis.

However, there is no corroborating evidence from descriptions of crucifixion victims or the experiences of reenactment subjects in the studies of Zugibe or Ball that changes in the shape or function of the thoracic cage or the shape of the epigastric hollow ensued with time on the crosses.

*Requirement 3 - The wrists of the crucifixion victim bear the majority of the body weight.*

With the evidence available about fixing crucifixion victims to the cross, most of the victim’s weight would have been on the feet with the arms nearly horizontal and the feet nailed straddling the cross or with the feet turned outward and nailed through the medial aspect of the calcanei to the cross (Alkimilla graffiti). Furthermore, the evidence from Mödder’s experiments revealed that even putting some weight on the feet for a few minutes at a time alleviated the breathing difficulties of tethered subjects.

*Requirement 4 - Victims had trouble breathing*

This is not supported by historical records or reenactment studies. However, if asphyxiation was the final common pathway of death for crucifixion victims, it would be reasonable to expect at least one ancient author to mention it. Multiple ancient authors mention crucifixion extending the breath of life, but none of them mention
crucifixion making it more difficult for victims to breathe.

**Requirement 5 - Victims would have to push up frequently to exhale sufficiently**

This has not been found in historical records, and multiple subjects were unable to do this motion even once during reenactment studies, even though they were in an air-conditioned room attached with leather straps instead of nails, and had not been tortured, starved, or dehydrated. And if they could not even push up once, how were they able to survive a day or more if the asphyxiation theory is correct?

Simply put, crucifixion is quite different from *anbinden*. In *anbinden*, for which we have some evidence of death by suffocation, *all* the victim’s weight is on the wrists, and the arms are in a vertical position. This is not crucifixion where the brunt of the weight is on the feet.

Two pieces of evidence that Barbet and Edwards mention to support the asphyxiation theory can be explained in other ways. First, they mention the wrist wound on the Shroud of Turin that shows two blood flows at a 5-degree angle and state that this can be best explained by the two different positions of the body when raised and sagging.

Assuming that the Shroud represents an actual crucifixion victim, the dorsal wrist would have been rubbing and smudged against the wood of the patibulum; it could not have shown two clear flows. Most likely, the body represented in the shroud was washed (Zugibe 1989a) and these two flows occurred post-mortem. The separation of the blood flows can be most easily explained by the blood flowing around the protuberance of the ulnar head.

The second piece of evidence was that Pilate ordered the legs of the thieves crucified beside Jesus to be broken to hasten death. *Crurifragium* was a stand-alone form of capital punishment in the Roman Empire, and no writing outside the Gospels has been found demonstrating another instance of combining crucifixion and shattering of the legs (ancient sources do not distinguish whether this just means the tibia or could include the femurs also) (Cook 2019, p. 249, footnote 65). While asphyxiation theory proponents state that leg-breaking would lead to rapid suffocation since victims could not rise on the cross, there is a simpler explanation.

Shattering the leg bones leads to tremendous blood loss:

“The estimated blood loss for a closed fracture of the femur is 1000–1500 ml and for a closed fracture of the tibia is 500–1000 ml. These figures can be doubled if the fracture is open. Fractures of the lower limb, particularly the femur, should be considered a potential cause of hypovolemic shock, especially if compound.” (Lee and Porter 2005)

It’s hard to imagine executioners doing less than causing open fractures of both tibias, and based on the above article, this suggests the loss of a minimum of two liters of blood—enough to cause death by shock even in a healthy patient. In victims who were already hemodynamically compromised and in a vertical instead of recumbent position, the loss of a few more liters of blood would rapidly push them to death.

Furthermore, any trauma, such as long bone fracture, can cause shock through a distributive/vasodilatory state induced by inflammation and thus compound already existing hypovolemic shock (Lenz, Franklin, and Cheadle 2007).

And finally, the gospels themselves provide evidence against the suffocation theory:

“And Jesus uttered a loud cry, and breathed his last.” (Mark 15:37)

Someone suffocating to death cannot cry out in a loud voice at the moment of death.

One of the defenders of the suffocation theory writes

“When somebody is totally exhausted, not being able to make the necessary effort to lift his body and breathe, it means that he has reached such a state that it is almost impossible to speak and have lucidity of mind.” (Papaloucas 2004)
This makes sense. Those who have witnessed people suffocating to death do not hear them cry out in a loud voice as Jesus did moments before dying. However, one of us (DAK) has witnessed patients in ventricular tachycardia able to yell out for help and another (ESF) has witnessed patients with impending death due to shock or other catastrophe (perforated viscus, aortic dissection, and pulmonary embolism) cry out prior to dying, but none of us has experienced this with patients with respiratory failure.

Indeed if patients cannot exhale, or if they suffer from ventilatory failure (rather than hypoxemic failure) the rising CO₂ would lead to confusion, followed by obtundation and later CO₂ narcosis (coma). This makes it likely that if Jesus were dying of progressive hypercapnia, he would become confused and ultimately more silent and not cry out. He would slide silently into death.

Even when Barbet wrote his book, he allowed his friend, Dr. PJ Smith to write an appendix that included the statement:

“Asphyxia, or respiratory failure as we prefer to call it, the author (Dr. Barbet) thinks was caused by the respiratory muscles becoming fixed in inspiration due to the falling forward of the trunk away from the vertical section of the Cross and the consequent inability to expire and so empty the lungs of carbon dioxide. This theory is not supported by some of the evidence set out in the book.”

“I am of the opinion that there is overwhelming evidence that Christ died from heart failure due to extreme shock caused by exhaustion, pain and loss of blood.” (Barbet 1953, 211)

**Could Crucifixion Victims’ Breathing Become Secondary Compromised?**

Ball (2008) wondered whether respiratory difficulty might be a function of time. It is possible that ventilatory failure could have occurred secondary to other, preceding factors, causing death in some victims of crucifixion. For instance, hypoxia and carbon dioxide retention as a manifestation of ventilatory failure may have been a late event in the progression towards death. Lactic acidosis may have occurred first due to dehydration/volume depletion from physical exertion, insensible loss from open wounds, and also from frank hemorrhage following the scourging.

Following blood and fluid volume loss, electrolyte disturbances would follow, particularly potassium and phosphorus which in turn lead to neuromuscular weakness and thus respiratory muscle weakness. This is seen in alcoholic patients or those with refeeding syndrome in whom hypophosphatemia is the cause of their respiratory failure. Burns are another important cause of hypophosphatemia, and broad surface areas denuded by the scourging may have led to physiologic changes mimicking burn wounds.

Significant electrolyte abnormalities may have caused cardiac arrhythmias such as atrial fibrillation that could contribute to hemodynamic compromise. In other words, crucifixion would set the victim up for secondary ventilatory failure due to volume depletion, neuromuscular weakness, and falling behind the ventilatory demands created by progressive lactic acidosis (metabolic acidosis).

However, in the case of Jesus, his lucidity and his ability to cry out loudly moments before his death demonstrate that suffocation was not playing a significant role—either primary or secondary—in his death.

**Summary**

The argument that Jesus died by suffocation primarily rests on the assumptions that the position of Jesus’ body on the cross prevented adequate air exchange and that Jesus’ weight was primarily borne by the wrists and not the feet. The suffocation theory requires that if victims could stay alive for hours to days on the cross, they would necessarily push up and down on the cross to achieve adequate exhalation. Reports of wrist-hanging torture (anbinden/aufbinden), in which suffocation played a significant role, are used to support this theory.
However, *anbinden* is not crucifixion. Ancient literary and graphic evidence reveals that in crucifixion, the arms are nearly horizontal compared to the vertical position in *anbinden*, and the weight of victims is borne primarily on the feet compared to the wrists bearing all the weight in *anbinden*. These facts lead to different causes of death in each form of torture. Ancient literature, including the Gospels, also reveal that victims could talk, spit, or yell out from the cross, even at the moment of death. A suffocation victim cannot do that.

Finally, two arguments used to support the suffocation theory are given alternative, simpler explanations. First, the two blood flows on the left dorsal wrist image on the Shroud of Turin are more likely post-mortem flows separating at the ulnar head, and they are not the product of two positions for exhaling and inhaling on the cross. Second, the legs of the thieves next to Jesus were most likely not broken to hasten death from blood loss and worsening of shock, as leg-breaking was a stand alone capital punishment in the Roman Empire that resulted in massive blood loss.

**Conclusion**

It is time to abandon the idea that asphyxiation was the main cause of death in crucifixion victims where the feet were attached to the cross, and therefore bore most of the body weight, and the arms were stretched out and attached to the patibulum. Therefore, we must apply our skills to look for a different over-riding cause or causes for death by crucifixion.

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