ISSN: 2584-0355
DOI: doi.org/10.51219/MCCRJ/Giulio-Fanti/193

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Vol: 3 & Iss: 1

Review

Evidence of Jesus' Hematidrosis on the Turin Shroud?

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Citation: Fanti G, Gregorek C. Evidence of Jesus' Hematidrosis on the Turin Shroud? *Medi Clin Case Rep J* 2025;3(1):741-749. DOI: doi.org/10.51219/MCCRJ/Giulio-Fanti/193

Received: 24 February, 2025; **Accepted:** 26 February, 2025; **Published:** 28 February, 2025

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ABSTRACT

A recent article on the characteristics of the blood present on the Turin Shroud (or Holy Shroud) has distinguished the blood into the following categories: Type A, B and C.

Type A blood, consisting of microcytes, has been classified as shed during the crucifixion or after the death of Jesus, while Type B blood has been referred to as blood coagulated on the skin following the blood drippings when Jesus was still alive during the Passion. On the other hand, Type C blood has not been well identified due to the lack of samples to analyze adequately.

Subsequent analyses have allowed us to characterize this Type C blood better consisting of erythrocytes with dimensions slightly smaller than those of human blood. This is purported to be the blood Jesus exuded during the agony of Gethsemane. The Gospel of Luke [22:44] describes a clear case of hematidrosis, a condition in which Jesus sweated blood so profusely that it dripped to the ground.

This article provides a detailed analysis of experimental findings and explains why the hypothesis that Type C blood is linked to Jesus' Hematidrosis in Gethsemane is plausible.

Keywords: Turn Shroud; Resurrection; Bloodstains; Hematidrosis; Erythrocytes; Osmolarity; Hypotonic solutions; Macrocytosis

Introduction

The TS (Turin Shroud or Holy Shroud) is one of history's most studied and debated religious Relics[1-6]. It is a handcrafted linen textile woven in a 3:1 herringbone twill pattern, measuring approximately 4.4 meters in length and 1.1 meters in width. The fabric bears the full-length, front and dorsal images of a human figure, inexplicably impressed upon the cloth. This figure displays wounds consistent with those of a man who underwent severe torture and crucifixion, aligning with descriptions found in the CHB (Christian Holy Bible) regarding the Passion and Death of Jesus, **(Figure 1)**.

Throughout history, the TS has been venerated as a sacred relic, with records tracing its presence in different locations across centuries. Pope Julius II (1443–1513) officially recognized it as an object of adoration[7], cementing its significance within Christianity. Historical analyses suggest that the TS may have been in Byzantium before the Sack of Constantinople (1204) and later made its way to Chambéry, France, before finally being

housed in Turin, Italy, where it remains. Byzantine coins[8] from as early as the 7th century depict facial features strikingly similar to those on the TS, fueling speculation that the Relic was known and revered long before its documented appearance in Western Europe.

Despite its historical and religious significance, the authenticity of the TS has been the subject of intense scientific scrutiny. One of the most controversial aspects of its study revolves around radiocarbon dating tests conducted in 1988, which placed the cloth's origin between 1260 and 1390 AD[9] - suggesting it was a medieval production rather than a 1st-century artifact.

However, this conclusion has been highly contested due to probable contamination, especially from environmental factors[10-14]. Some[15,16] have argued that selective radioactivity could have biased the radiocarbon results, with hypotheses linking the anomaly to the Resurrection of Jesus Christ.

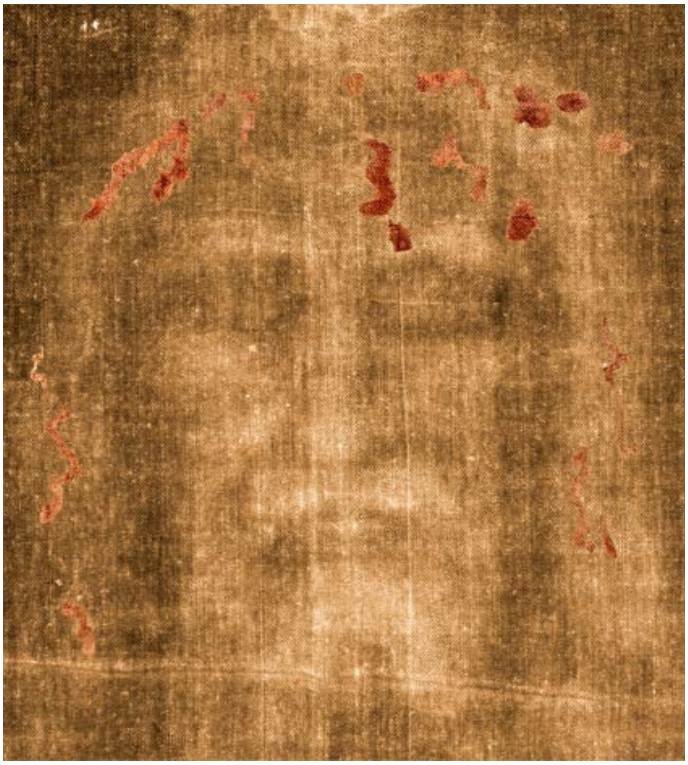

Figure 1: Face of Jesus Christ on the TS. The first Author added positive bloodstains to the negative image.

Beyond radiocarbon dating, the TS exhibits unique physical and chemical properties that challenge conventional explanations. Studies on Beta radioactivity and fluorescence in the bloodstains[16] suggest that the blood on the cloth interacted with energy-light in unusual ways, hinting at an extraordinary event that affected the fabric.

Additionally, forensic examinations[17-20] confirm the presence of liquid blood with no smearing, meaning the body was not moved or manipulated after bleeding onto the cloth. Strikingly, there is no evidence of putrefaction, an anomaly that remains scientifically unexplained and raises further questions about the nature of the image formation.

Recent studies[17-20] have also explored the concept of "material transparency" concerning the TS, examining how its fibers interact with energy-light. Moreover, investigations into the bloodstains provide further insights, reinforcing that the blood is consistent with wounds caused by flogging, crucifixion and piercing by a sharp object paralleling the CHB account of Jesus' Passion.

As scientific inquiry continues, the TS remains an unparalleled mystery, straddling the realms of faith, history and science. Whether viewed as a holy Relic or an unresolved enigma, the TS continues to captivate scholars, theologians and scientists alike - its secrets still waiting to be fully uncovered.

This article will also introduce an intriguing aspect: the presence of blood even before the scourging and the crucifixion, as described in Luke [22:44], which recounts Jesus' sweating drops of blood in Gethsemane - a phenomenon known as hematidrosis induced by extreme stress. Studying blood traces on the TS may provide further clues about this rare but documented medical condition, offering an additional potential link between the CHB narrative and forensic analysis.

Summary of Physical Conditions of Jesus During Passion

The physical suffering endured by Jesus Christ during His Passion, crucifixion and entombment is among the most extensively studied aspects of His life, both from a theological and forensic perspective.

CHB accounts, historical records and modern scientific analyses - especially those related to the TS - offer profound insights into His physiological state during these final moments. This summary synthesizes existing research, tracing Jesus' suffering from the Last Supper to His burial in the Sepulcher, with a particular focus on the novel insights provided by the TS regarding His post-mortem condition and departure from the Relic, estimated to have occurred 30 to 40 hours after death[16-19].

The Agony in Gethsemane: Extreme Stress and Hematidrosis

During the Last Supper, Jesus began to experience a heart condition (referred to as *crepacuore* in Italian), triggered by the psychological stress of being near Judas, the traitor. Later that night, in the Garden of Gethsemane, Jesus underwent an intense emotional and physiological crisis. According to Luke [22:44], He suffered hematidrosis, a rare condition in which extreme stress causes blood vessels in the sweat glands to rupture, leading to blood-tinged perspiration. This rare but documented phenomenon[21,22] indicates severe psychological distress, which weakened Jesus before His subsequent physical torments.

The profound psychological stress Jesus experienced in Gethsemane was driven by multiple factors. He faced the impending separation from God the Father and the immense burden of bearing the world's sins on His human psyche. His anguish intensified with the realization that His suffering would be in vain for many who would ultimately reject Him. This deep awareness, combined with overwhelming emotional and physiological strain, contributed to the extreme distress He endured.

Let us not forget, in the Garden of Gethsemane, Jesus, with His foreknowledge, knew that He would undergo an extremely brutal pre-crucifixion scourging and that He - God- was destined to be crucified and humiliated with a punishment deemed dishonorable for even convicted Roman murderers.

One must also try to imagine His pain in knowing the gut-wrenching anguish His beloved Co-Redemptrix Mother (a

helper in the Redemption) would experience in witnessing all of this.

Such factors led God-Incarnate to simultaneously reach the apex of His anguish while also displaying the greatest evidence of His humanity, His sweating blood as He prayed to His Father, pleading to be relieved from the most pitiable of pain He was to endure in atoning for the sins of humanity.

The cardiac event that had already begun reached its apex in these moments as the Son, while pleading for grace, subordinated Himself to His Father's will.

Arrest, Beatings and Mockery: Early Physical Trauma

Following His arrest, Jesus endured repeated beatings, blows to the face and psychological humiliation at the hands of the Jewish authorities and Roman soldiers. The TS reveals injuries consistent with these accounts, including swelling of the face, a broken nasal cartilage and contusions on the cheeks. These injuries likely resulted in blood loss and early dehydration, exacerbating His deteriorating condition.

The Scourging: Brutality of Roman Flagellation

Roman flogging was an exceptionally brutal form of punishment. The TS shows over 370 wounds, consistent with those inflicted by more than one kind of flagrum (Roman whip with multiple leather thongs embedded with metal or bone fragments). This scourging caused deep lacerations, muscle damage and severe blood loss, leading to hypovolemic shock-a life-threatening condition resulting from substantial blood depletion. The physical toll of the flogging alone would have left Jesus in excruciating pain, extreme weakness and near collapse.

The Crown of Thorns: Additional Blood Loss and Neurological Pain

Unlike traditional depictions, Roman crucifixion did not typically involve a crown of thorns. However, the CHB records Jesus' coronation with thorns as a historical event. It was an act of mockery by Roman soldiers. For Christians, it symbolizes His coronation as the King of Redeeming Sorrows.

The TS shows evidence of puncture wounds on the forehead, temples and nape, corresponding to a circular band probably composed of three rings of thorn branches of the type Rhamnus Lycioides (a species of hawthorn).

These injuries would have caused profuse bleeding due to the vascularity of the scalp, as well as trigeminal nerve pain, producing an excruciating burning sensation.

The Carrying of the Cross: Falls and Shoulder Trauma

Jesus was forced to carry His cross, as indicated by the TS, which shows deep abrasions on both shoulders, suggesting He bore the weight of a full wooden cross.

Tradition and physical evidence from the TS, including a right shoulder dislocation and knee contusions, indicate that He fell multiple times. These repeated falls likely further weakened His body and may have caused additional internal bleeding[23].

Crucifixion: Extreme Pain

Crucifixion was a prolonged form of execution designed to induce a slow death through exhaustion and excruciating pain with muscle spasms (tonic and clonic contractions). The TS provides forensic evidence of nail wounds in the hands and feet; in particular, the nail exit on the carpo-metacarpal area of the left hand is evident.

Already severely weakened by the flagellation and the resulting hypovolemia (insufficient blood quantity), Jesus likely suffered from hypoxemia (insufficient oxygenation). This condition was caused, in part, by microcytic red blood cells, which had shrunk due to the accumulation of urea in the blood that His kidneys-damaged by the flagellation-could no longer filter properly.

The wound in His right side, corresponding to the CHB narrative of a spear inflicted by a Roman soldier [John 19:34], confirmed Jesus' death. The TS shows a flow of blood mixed with a watery fluid (serum), suggesting a hemothorax with hemopericardium. This medical evidence is consistent with current forensic interpretations of death by crucifixion.

The Burial and the Mystery of the TS

The body of Jesus was taken down from the cross and wrapped in a linen cloth, the TS, according to Jewish funeral customs. Forensic studies of the bloodstains from the TS reveal intact rings of blood serum[1], indicating that the blood remained liquid and unaltered. Furthermore, the absence of signs of putrefaction suggests that the body of Jesus did not undergo the typical decomposition that begins about 40 hours after death[18,19].

A particularly mysterious aspect of the TS is the absence of smearing in the still-liquid bloodstains, making Jesus' exit from the cloth-occurring 30 to 40 hours after His death-scientifically inexplicable[19]. The most reliable hypothesis is that this extraordinary occurrence corresponds to the Resurrection of Jesus Christ[18,19]. The image on the cloth was formed through an unknown process, seemingly linked to a sudden burst of energy-light. This phenomenon resembles the Holy Fire[24], a miraculous event occurring annually in the Holy Sepulcher Basilica in Jerusalem.

The testimony on the TS of Redemption and Resurrection

The immense physical suffering endured by Jesus Christ, compounded by the moral anguish of humiliation as documented in the CHB and supported by the forensic evidence of the TS, represents perhaps the most intense form of human agony recorded in history.

The Passion of Jesus involved extreme psychological stress, repeated beatings, severe hypovolemia, hypoxemia and multiple neuralgia, which, together with other pathologies, led to death on the cross by cardiac tamponade.

The enigmatic qualities of the TS, particularly the properties of blood and the inexplicable formation of the image, continue to defy scientific explanations and can only be explained by reference to a miracle connected to the Resurrection[19].

Whether the TS is viewed as a scientific or historical document or religious testament, the study of the Passion of Jesus through forensic, medical, scientific and theological lenses offers profound insights into the suffering freely endured by Jesus for the redemption of humankind.

Hematidrosis Described By Evangelist Luke

The phenomenon described in Luke [22:44] where Jesus, in the Garden of Gethsemane, is said to have sweated drops

of blood, has long been a subject of theological and medical inquiry. The passage, written in Greek, states: "καὶ γενόμενος ἐν ἀγωνίᾳ ἐκτενέστερον προσηύχετο. ἐγένετο δὲ ὁ ἱδρὼς αὐτοῦ ὡσεὶ θρόμβοι αἵματος καταβαίνοντες ἐπὶ τὴν γῆν."

That, translated in English is: "And being in an agony he prayed more earnestly. And his sweat became as it were great drops of blood falling down to the ground."

This description has often been debated-whether Luke intended it as a literal medical condition or a figurative expression of Jesus' extreme distress. However, modern medicine confirms[21,22] that hematidrosis is a real, though rare, physiological condition, lending credibility to the literal interpretation of Luke's account, **(Figure 2)**.

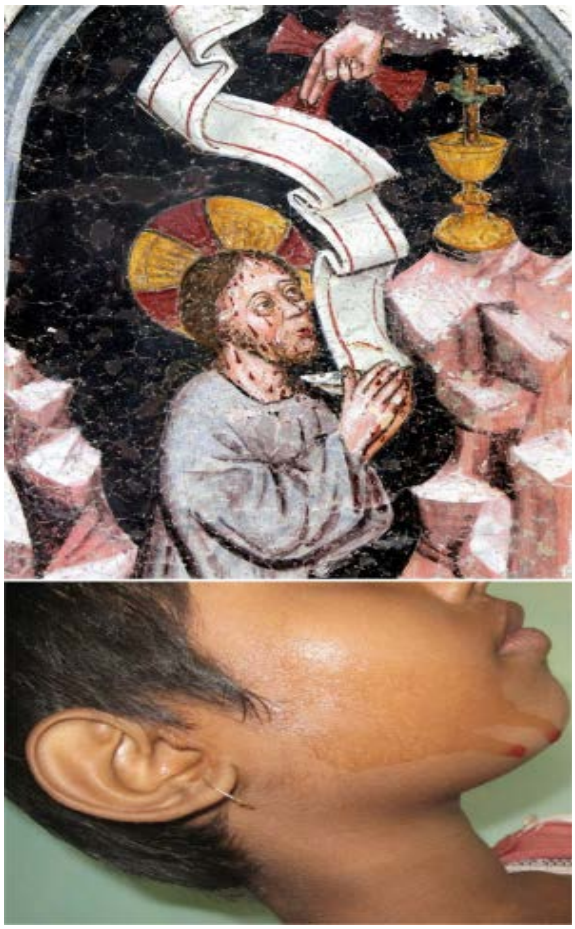

Figure 2: On the top, hematidrosis of Jesus in the Gethsemane (Taisten-Tabernakelbildstock 04 - GNU FDL). On the bottom is a real example of hematidrosis[22].

Medical Explanation of Hematidrosis

Hematidrosis, sometimes called blood sweat, is a rare disorder that occurs under conditions of extreme physical or emotional stress. It results from intense neurovegetative stimulation, which causes:

- Dilation and increased permeability of blood vessels surrounding the sweat glands.
- Rupture of capillaries, leading to leakage of red blood cells into the sweat ducts.
- Mixing of blood with perspiration, which then appears as red-tinged sweat.

Cases of hematidrosis have been reported in individuals undergoing severe fear, extreme stress or deep psychological anguish-consistent with the state of agony Jesus experienced before His arrest and crucifixion. The extreme anxiety and distress He endured would have triggered a massive autonomic nervous system response, leading to this rare but scientifically documented condition.

Theological and Linguistic Analysis of Luke [22:44]

Luke, being a physician (Colossians [4:14]), was likely aware of medical conditions and their descriptions. His use of ὡσεὶ θρόμβοι αἵματος (hōsei thromboi haimatos, "as it were great drops of blood", literally "clots of blood") suggests that he was describing a literal phenomenon rather than a mere metaphor for extreme anguish.

The phrase ὡσεὶ ("as it were") could indicate either similarity or an actual occurrence, but given the known existence of hematidrosis, many scholars argue that Luke intended to describe an actual, physiological event.

Furthermore, the phrase ἐν ἀγωνίᾳ (en agonia, "being in agony") highlights the extreme emotional torment Jesus endured. The word ἀγωνία (agonia), from which the English term agony derives, conveys an intense struggle, often associated with mortal fear or extreme mental distress. This aligns with the physiological triggers of hematidrosis.

It is also significant that Luke indicates that these drops of blood καταβαίνοντες ἐπὶ τὴν γῆν "fell to the ground." So, we must assume that it was a very intense hematidrosis that was not limited to a simple sweating of blood on the face but so realistic and intense that even drops of blood fell to the ground.

Significance of Hematidrosis in the Passion Narrative

The presence of hematidrosis in Jesus' Passion has profound medical, theological and symbolic implications.

- Medically, it indicates that Jesus' suffering began long before the Passion. His body was already in a weakened and dehydrated state even before His scourging and crucifixion, intensifying His overall physical burden.
- Theologically, it fulfills prophetic descriptions of the Messiah's suffering (Isaiah [53:3-5]), reinforcing that Jesus bore extreme anguish even before His arrest.
- Symbolically, the presence of blood before the actual shedding of blood on the cross emphasizes the total sacrifice of Jesus-not just in death, but in His profound suffering. His suffering began even before His arrest, as He shed blood in Gethsemane and continued as He endured immense physical and emotional torment leading to His crucifixion.

Jesus' Hematidrosis in the Gethsemane

Therefore, Luke's account of Jesus sweating blood in Gethsemane is not merely a poetic expression of distress but an actual medical condition known as hematidrosis. The intense psychological agony preceding His Passion was so extreme that it triggered a rare but documented physiological response.

This phenomenon confirms the physical toll of Jesus' suffering and provides deeper insight into the immense burden He bore before His crucifixion, making the Passion narrative even more profound from both a medical and theological perspective.

Materials and Methods

Ref.[16] provides a detailed description of the samples that were analyzed to study the different blood types.

(Figure 3) illustrates the sampled areas and the types of sampling considered in this article. Below is a brief description of these samples.

- Point 1 corresponds to STuRP (Shroud of Turin Research Project) sticky tape 1EB put in contact with the calf of the TS dorsal image.
- Point 2 corresponds to STuRP sticky tape 1HB put in contact with the feet of the TS dorsal image.
- Point 3 corresponds to STuRP sticky tape 3EF put in contact with the wrist of the TS frontal image.
- Point 4 corresponds to STuRP sticky tapes 3AF put in contact with the finger of the TS frontal image.
- Area e corresponds to the dust vacuumed from the back of the TS at the hands' area.
- Area f corresponds to the dust vacuumed from the back of the TS at the face area.
- Area g corresponds to the dust vacuumed from the back of the TS at the feet area, dorsal image.
- Area h corresponds to the dust vacuumed from the back of the TS at the glutei and legs, dorsal image.
- Area i corresponds to the dust vacuumed from the back of the TS in correspondence with the C14/1988 area which, being in a corner, also collected dust coming from the surface of the TS in correspondence with the legs and feet of the frontal image.

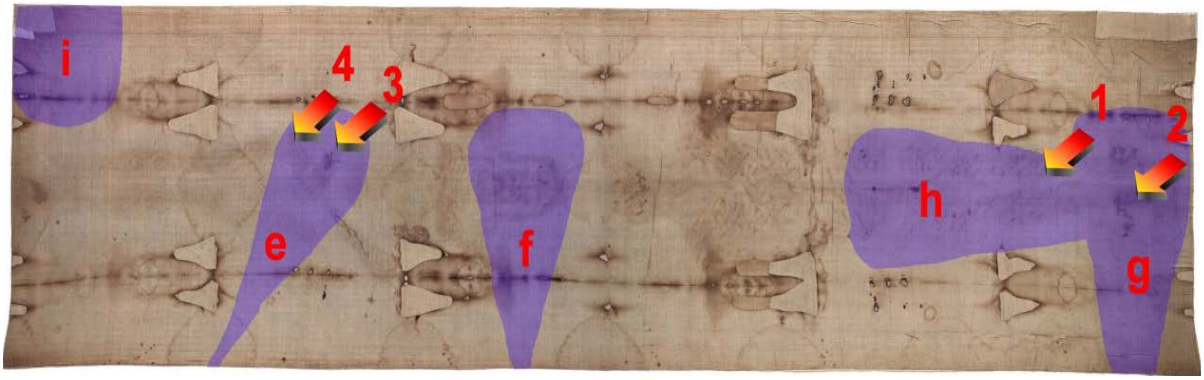

Figure 3: sampled areas of the TS and types of sampling considered in this article. The letters e, f, g, h, i indicate the areas where the dust was vacuumed from the back of the Relic, while the numbers 1-4 indicate the areas where the samples were taken using sticky tapes.

The first Author initially documented the samples using an Olympus Zoom stereomicroscope. Then, the samples were analyzed with optical, phase contrast and petrographic (or polarizing) microscopes in reflected and transmitted, visible and UV light with magnifications up to 1500x.

Further analyses were performed with SEM (Scanning Electron Microscope), ESEM (Environmental Scanning Electron Microscope) and SEM-FEG (Field Emission Gun). Additionally, Raman analysis was conducted to detect hemoglobin, a key component characteristic of blood. The element weight percentages of the particles in question were determined via XRF-EDS (Energy Dispersive X-ray Fluorescence Analysis), also called EDX (Energy dispersive X-ray spectroscopy).

It is immediately observed that, although the sampling from the TS was not extensive due to the limitations posed by Turin Authorities, it appears to be sufficiently distributed across the entire area of the Relic. This distribution allows for some preliminary conclusions regarding the extent to which the single microscopic types of the material analyzed are more widely distributed or more localized in specific areas.

Three Different Types of Blood Detected

Ref.[16] recently distinguished three different types of blood coming from the TS, they are the following.

Type A blood

It consists of numerous orange-red particles that both adhere to the TS linen fibers and are isolated in the tape's adhesive. These rounded discoidal particles appear like a donut with central concavity, **(Figure 4)** and it is very similar to that of ordinary human erythrocytes, **(Figure 5)** on the top. This Type A blood is very similar to that reported in Ref.[25].

These particles of Type A blood evoke microcytes. While human blood cells typically measure 7-8 micrometers, these particles range from 0.3 to 2 micrometers, with 0.7 micrometers being most common. Therefore, one can suppose these particles are microcytes derived from erythrocytes of uncoagulated blood that underwent strong shrinkage. Given that Jesus was suffering from very high uremia due to the flagellation which probably induced kidney failure, this microcytic anemia suggests the extreme difficulties He had in exchanging oxygen (hypoxemia). The high levels of creatinine detected in this Type A blood can be easily explained by this supposed kidney failure. Type A blood suggests its identification with post-mortem blood or with blood dripped in the last moments of life on the cross.

This Type A blood is very particular because, unlike common blood, it shows a red-orange fluorescence when observed under ultraviolet light and a notable Beta radioactivity (i.e., electron emission). This phenomenon will require further analysis in the future as it is challenging to explain, especially when considering blood samples that are two millennia old.

Type B blood

It was prevalently found in Areas f and h of **(Figure 3)** and consists of compact, but brittle, sherds of crusts of a darker color than Type A blood, **(Figure 6)**. It is rarer than Type A blood and, therefore, less easy to characterize.

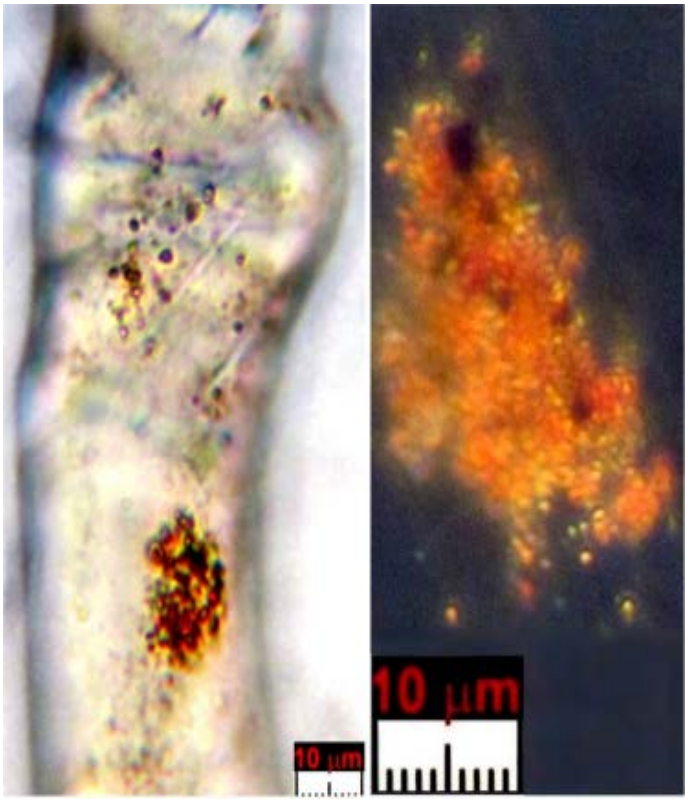

Figure 4: Examples of microcytes of Type A blood coming from sticky tape 3EF.

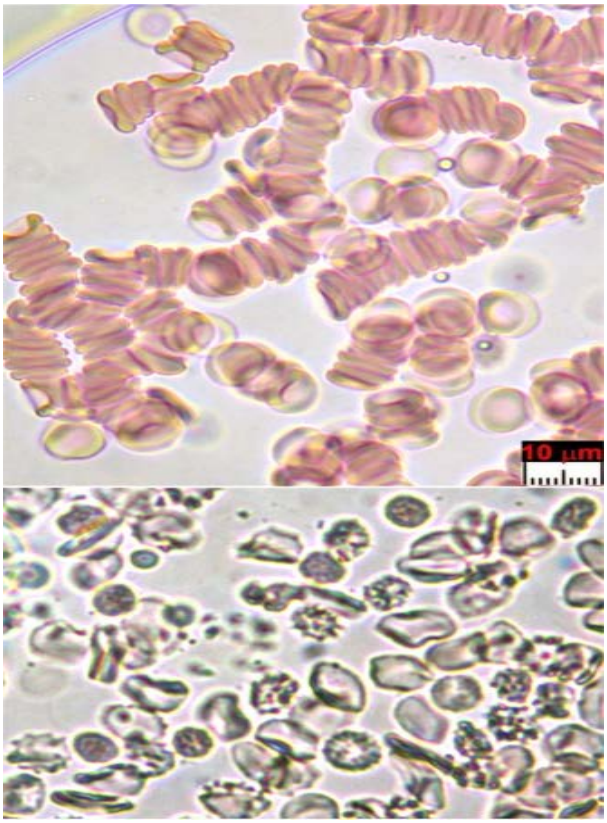

Figure 5: Examples of common human blood erythrocytes on the top and echinocytes with macrocytes on the bottom.

Its element composition is compatible with that of blood; its size is up to a tenth of a millimeter and it has shapes that are not rounded, but its edges suggest previous fragmentations of larger particles. Other smaller sherds, with sizes of a few micrometers, have also been observed in 2, 3 and 4 sticky tapes of **(Figure 3)**.

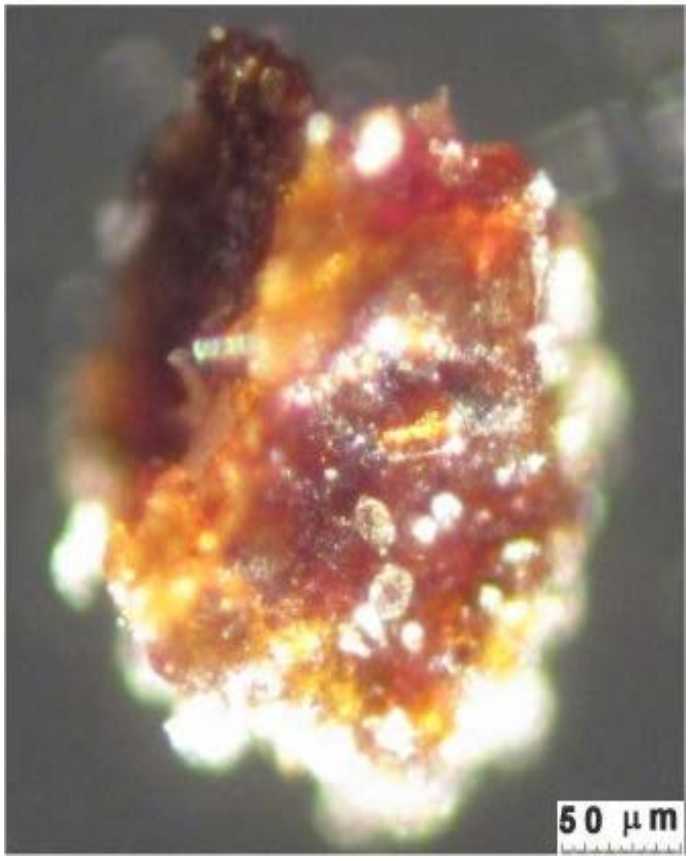

Figure 6: Example of Type B blood (Sample GF-h18).

This type of blood does not show directly, with an optical microscope, the typical microstructures of the red blood cells found in Type A blood.

This fact leads one to think that it can be classified as pre-mortem blood that coagulated on the skin from open wounds while Jesus was still alive. Therefore, it was not mixed with the anti-putrid aromatics later used for the burial of the corpse.

Similarly to common blood and unlike Type A, Type B blood is not fluorescent when observed in the ultraviolet and does not show Beta radioactivity. However, it seems to emit Gamma radiation (i.e., photon emission) whose measured level was close to the detector background noise. For this reason, it will have to be analyzed in the future with more sensitive instrumentation.

Type C blood

Ref.[16] described Type C blood as a material consisting of very rare donut-shaped particles found only in correspondence with the face area. Nevertheless, the composition of these particles could not be determined because of a shortage of material to test.

It reported that the particle diameter ranges from 2 to 5 micrometers and that this structure is compatible with that of erythrocytes, **(Figure 7)**. Other erythrocytes classified as Type C blood have recently been found through the SEM-FEG microscope in Area f corresponding to the TS face, **(Figure 8)**; they show elemental composition typical of common erythrocytes.

G. Lucotte in Ref.[26] also found erythrocytes that can be classified as Type C by studying a small sticky tape (1.36 millimeters high and 614 micrometers wide) placed in contact with the surroundings of a blood area of the TS face. In fact, many of them are still well preserved and similar in form and

elementary composition to that reported in **(Figure 8),** having variable dimensions from 2 to 7 micrometers.

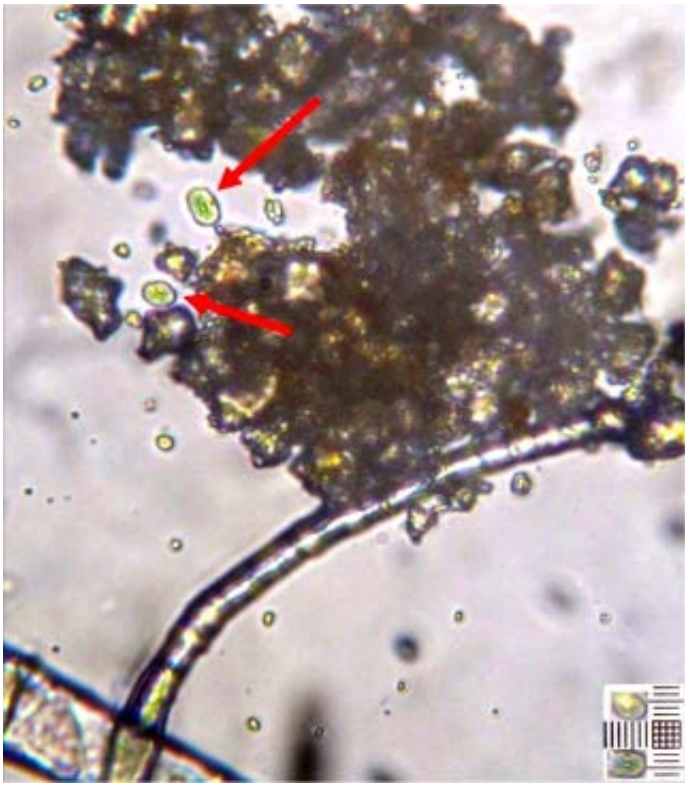

Figure 7: Type C blood (Sample GF-h18).

Therefore, one can confirm that the Type C blood consists of individual well-preserved erythrocytes of variable dimensions between 2 and 7 micrometers, all coming from the TS Face area.

Evidence of Jesus' Hematidrosis?

Ref.[20] confirms what is reported in Ref.[16] stating that subsequent analyses detected the presence of other erythrocytes of dimensions slightly smaller than those typical of human blood. It also hypothesizes that Type C blood was shed before the uremia that shrank the erythrocytes due to Jesus' flagellation. Consequently, Ref.[20] anticipated that it could be thought that these blood cells can be directly correlated to the hematohidrosis manifested by Jesus in the Gethsemane. Now, considering this hypothesis but, before continuing, it seems necessary to make some additional observations.

Supposing that the particles in question are erythrocytes, Ref.[16] stated that they did not coagulate because they were mixed with a hypothetical oily substance, probably thinking of the oily mixture of aloe and myrrh mentioned in the CHB [John 19:39].

This hypothesis, however, does not prevent thinking that the possible oily mixture of aloe and myrrh was placed when the erythrocytes under examination were already spread on the skin of the face and that they were previously mixed with sweat, probably related to the hematidrosis that occurred in Gethsemane.

Ref.[16] also stated that the larger dimensions of Type C erythrocytes compared to those of the Type A blood could be explained by the fact that these particles were scattered on the skin when Jesus was not yet in the final phase of the supposed uremia and, therefore, the erythrocytes never completely shrank in size.

This observation seems correct but must be integrated with some considerations on the swelling or shrinking of erythrocytes due to the osmolarity (biophysical value in mOsm/l, milliosmoles per liter, which expresses the number of particles, such as ions, present within a solution) of the liquids in which they are immersed.

It is known that, while isotonic solutions (like those having a solution of 0.9% in weight of NaCl or those having a solution of 5% in weight of glucose in fresh water) have the same concentration or osmolarity, of particles present in solution in the erythrocytes and therefore, the same osmotic pressure (that is between 240 and 340 mOsm/l, but frequently between 275 and 300 mOsm/l – meaning that there are $0.3x6.022x10^{23} = 1.8x10^{23}$ molecules that do not pass through the erythrocytes membrane); hypotonic solutions have lower concentrations of solutes and hypertonic solutions have a higher concentration than that of erythrocytes.

Consequently, by osmosis, erythrocytes immersed in hypotonic solutions tend to swell (macrocytosis, because water tends to move inside the cell) becoming turgid until they burst, while erythrocytes immersed in hypertonic solutions tend to shrink and wrinkle (microcytosis). **(Figure 5)** on the bottom is an example of erythrocytes damaged by a different osmotic pressure of the liquid in which they were immersed.

Since human sweat is a hypotonic (or hypoosmotic liquid with a concentration between 80 and 180 mOsm/l) it tends to swell the erythrocytes immersed in it, for example, during hematidrosis.

However, it is necessary to consider the probable shrinkage of erythrocytes over time, also due to drying. In a similar case, Ref.[27] studied the possible shrinkage of erythrocytes due to drying in Egyptian mummies and found erythrocytes in the blood of a softened and rehydrated scalp of a mummy. After rehydration (fresh water has an osmolarity of 2 a 5 mOsm/L), it detected rounded discoidal elements with central concavity and a diameter of 4-5 micrometers.

Consequently, the erythrocyte of **(Figure 8)** which has a diameter of 6 micrometers, like the others found in similar samples (having variable diameter from 2 to 7 micrometers), can be thought of as the result of an erythrocyte that swelled (and therefore increased its diameter more than the 7-8 micrometers typical of human blood) following immersion in a hypotonic liquid such as sweat, but then it dried out over time and shrunk in size. The wrinkled surface of the erythrocyte in question seems to confirm this drying out over time.

From these considerations, one can suppose what happened to the erythrocytes of Type C blood. Ref.[17] reports that the body of Jesus was not completely washed but only cleansed. If the body had been completely washed it would not be possible to think that any trace of the hematidrosis that occurred in Gethsemane remained.

In agreement with Refs.[16-20] one can assume that the erythrocytes of the blood of Jesus of the HS remained unchanged until, during the flagellation the kidneys suffered a block and the urea spread in the blood causing an acute microcytosis that reduced the diameter of the erythrocytes even by a factor of 10.

However, the erythrocytes related to hematidrosis, mixed with sweat which is a slightly hypotonic solution, swelled without bursting, thus maintaining their discoid shape with the central concavity.

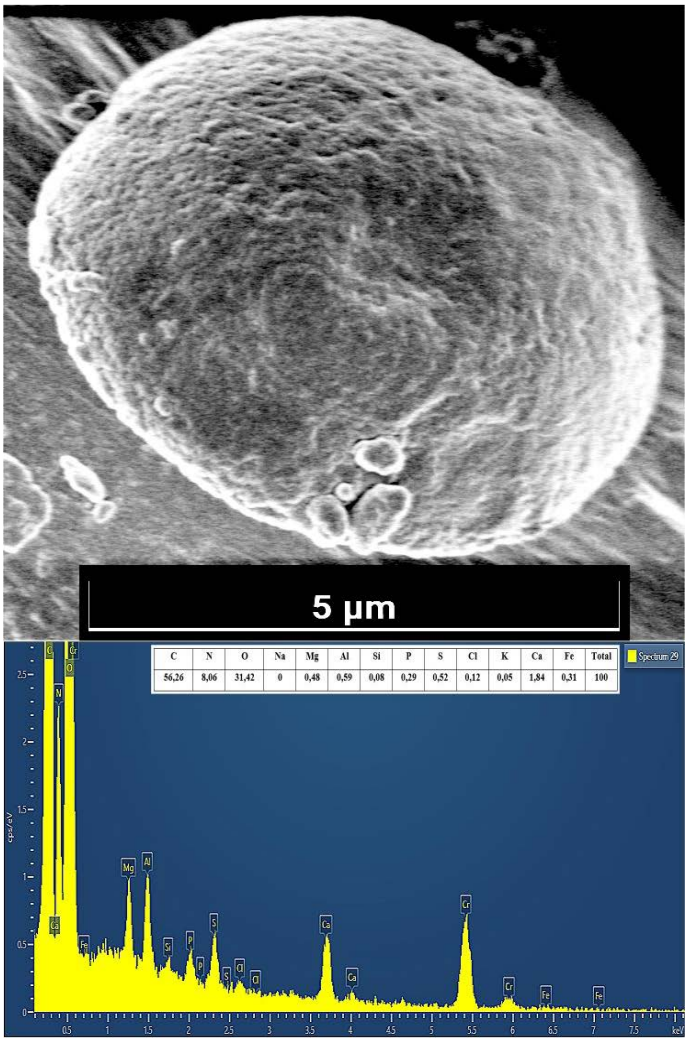

Figure 8: Recently detected erythrocyte classified as Type C blood.

Since the face of Jesus was only cleansed, several erythrocytes due to hematidrosis remained on the skin of the face, which was then smeared with an oily mixture of aloe and myrrh which had the double function of shrinking these erythrocytes but also preserving them well over time.

It is interesting here to comment on the "second and most abundant class" of erythrocytes mentioned in point 3 on page 150 of Ref.[28], consisting of red blood cells with a diameter of the order of 12.5 micrometers, indicated by G. Lucotte as not of human but presumably of animal origin. The authors, on the basis of the analyses here performed, believe that these macrocytes are of Type C blood due to prolonged immersion in a hypotonic liquid such as sweat, thus confirming the supposed hematidrosis of Jesus suffered in Gethsemane.

Because Type C blood erythrocytes come only from the facial area of the TS and not from other areas, it does not seem easy to contradict the hypothesis that the erythrocytes found in the Type C blood are related to Jesus' hematidrosis in Gethsemane.

Conclusion

Recent studies on the characteristics of the blood present on the TS[16] have distinguished the blood into the following categories: Type A, B and C based on the physical and morphological characteristics of the particles analyzed.

That article assumed that type A blood, composed of microcytes, is that which was shed during the crucifixion or after the death of Jesus, while type B blood is that which coagulated on the skin following the blood flowing down when Jesus was still alive during the Passion.

Type C blood, which was not identified with certainty in Ref.[16] due to a lack of samples and was preliminarily linked to hematidrosis in Ref.[20], has been analyzed in greater detail here, following the discovery of additional specimens, also in agreement with the finding of Ref.[28], that could aid in better identification.

The erythrocytes of this type C blood are slightly smaller (diameter of 2-7 micrometers) than those of human blood (diameter of 7-8 micrometers) and very well preserved in their shape and all come from the area of the TS face.

After having considered the possible transformations of these erythrocytes following their immersion in hypothetical human sweat which is a hypotonic solution (variable from 80 to 180 mOsm/l), their subsequent treatment with an oily mixture of aloe and myrrh during the preparation of the cadaver in the sepulcher and their subsequent drying for two millennia, it does not seem easy to contradict the hypothesis that this Type C blood can be correlated to the blood exuded by Jesus during the agony of Gethsemane; in fact, the CHB [Luke 22:44] reports that Jesus endured an evident hematohidrosis. This caused an intense sweating of blood that caused drops of blood to fall to the ground.

Future studies based on new samples taken directly from the TS will be able to confirm the hypothesis formulated here, that supposed Type C blood was due to the hematidrosis of Jesus in the Gethsemane.

If this hypothesis is confirmed as the authors suppose, even in the present study concerning the TS, the most important Relic of Christianity, they observe how the study of the characteristics of Type C blood brings the scientific results closer to those described in the CHB confirming the strict relations between science and faith.

Acknowledgments

The authors thanks Jacopo Nava, technician of the "Geosciences-GEO" Research Laboratories of the University of Padua for the microanalyses performed and shown in **(Figure 8)**.

The first author heartily thanks the late Prof. Don Lieto Massignani, who highly encouraged the writing of this paper and the Holy Spirit; he also thanks all the institutions and scholars mentioned in Refs.[16,19] and related papers who provided him with material from the TS.

Ethical Statements

As more widely reported in Ref.[19] the authors, belonging to the Christian Roman Catholic religion, experienced a profound strengthening of faith through scientific studies on the TS.

Funding

This research too was supported by a religious group, reported in Ref.[19] that entrusted the first author with the analysis of the so-called "Padre Pio handkerchief".

Conflicts of Interest

The authors declares no conflict of interest.

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