Review article
Pregledni članak

Acta Med Hist Adriat 2019; 17(2);305-312
https://doi.org/10.31952/amha.17.2.8

ANATOMY OF THE RIBS AND MANAGEMENT OF THEIR FRACTURES AS VIEWED BY AVICENNA (980-1037 AD)

ANATOMIJA I LIJEČENJE PRIJELOMA REBARA U AVICENINU PRIKAZU

Shahram Paydar[*], Armin Akbarzadeh[**], Shahram Jahanabadi[***]

Summary

Introduction: Avicenna stated interesting points on the symptoms of rib bone fractures, their physical examination, and also treatment and management of the complications in his master piece Canon in Tibb.

Method: We reviewed Avicenna's Canon and his viewpoints on the anatomy of the rib bones and their fractures and compared it with conventional medicine. Result: He described the anatomy of the ribs; he explained the effectiveness of their structure in the protection of vital organs. He also suggested some methods for the management of rib fractures, such as using vacuum at the fracture site or open surgery in case of complications. Conclusion: Avicenna's point of view on the approach toward rib fractures had some similarities and differences with conventional practice. Some of his suggestions could be taken into account.

Keywords: *Avicenna, ribs anatomy, rib fracture, true ribs, false ribs, Canon of Medicine-*

[*] Trauma Research Center, Shiraz University of Medical Sciences, Shiraz, Iran.

[**] Bone and Joint Diseases Research Center, Department of Orthopedic Surgery, Chamran Hospital, Shiraz University of Medical Sciences, Shiraz, Iran.

[***] Department of Surgery, International Branch, Shiraz University of Medical Sciences, Shiraz Iran.

Correspondence Address: Armin Akbarzadeh, Department of Orthopedic Surgery, Bone and Joint Disease Research Center, Chamran Hospital, Shiraz University of Medical Sciences, District 6, Chamran Blvd, 71948-15644 Shiraz, Iran.
E-mail: armin.akbarzadeh@ymail.com.

Introduction

Ibn Sina or Avicenna was one of the most reputable philosophers and physicians of the 12th century. His master piece the Canon in Tibb has been studied as a reference in Western countries for many years.[1] In the Canon, Avicenna explains the fractures of each bone separately.[2,3] One of the bones discussed is the rib; he stated some interesting points on the symptoms of rib bones fractures, the physical examination, and also treatment and management of the complications.[4] In the present study, we reviewed Avicenna's viewpoints on the rib bones anatomy and their fractures as stated in the Canon of Medicine.

Materials and methods

We studied Avicenna's viewpoints about the anatomy of the ribs as stated in the Canon of Medicine and compared it with conventional medicine.

Anatomy of the human skeleton can be found in a manuscript handing over Avicenna's Canon.[5]

Results

Avicenna classified the ribs into two groups: true ribs and false ribs. In addition to describing the anatomy of the ribs, he explained the effectiveness of their structure in the protection of vital organs.

> *"ribs protect the organs inside the thorax including the respiratory system and upper parts of the digestive system and it is not accreted so that it does not get heavy and also if any part gets injured, other regions do not get impaired. Also, it expands easily during its natural process or when the abdomen is full of air or food and the chest needs more space for the air, and also because of the chest muscles and other contents. Since the chest contains the*

---

1 Siraisi NG. (2014) Avicenna in Renaissance Italy: The Canon and medical teaching in Italian universities after 1500, Princeton University Press.

2 Usmanova R. (1980), Avicenna on the musculoskeletal system, Arkhiv anatomii, gistologii i embriologii,79 (9): 112-4.

3 Mazengenya P, Bhikha R. (2018), Revisiting Avicenna's (ad 980–1037) anatomical concepts of the musculoskeletal and peripheral nervous systems in the Canon of Medicine. Acta medico-historica Adriatica, 16 (2): 267-82.

4 Bemelman M, Long W, Mayberry J. (2018), History of rib fracture management. Rib Fracture Management: Springer; p. 1-24.

5 Goodrich JT. (2004), History of spine surgery in the ancient and medieval worlds, Neurosurgical focus, 16 (1): 1-13.

lung, heart, and related parts, it is important to have a maximum protection because any injury to them causes a big problem; nevertheless, protection to these organs should not cause tightness for them. Thus, the seven upper ribs are created so that they surround its inner organ completely by attaching to the sternum at the anterior part, but those ribs which surround the digestive system protect the posterior side, where it is not under sight, and do not reach the sternum, and the distance between the extremities of the ribs gests longer in the lower ribs in order to provide enough space for the stomach for food and air, while it is protecting the spleen, liver and other organs. The seven upper ribs contain seven ribs at each side and the middle two ribs are longer than the others because this shape allows them to surround the inner organs from all aspects. These ribs deviate into inferior part with their curvature and then return back upward and attach to the sternum; as explained before, this provide more space. At the back joints, two prominences from each rib are attached to two fossa in the each wing of the vertebral bone, and this is the location of the seven upper ribs with the sternum. However, the other five ribs include free ribs and false ribs. The extremities of the ribs are attached to the cartilage, so they get protected from trauma and also to prevent their sharp extremities to have contact with the soft tissues and pardeh hajez *(peritoneum) and instead of that a material which is moderate in hardness and softness locate between them.*"

He emphasized that the separated rib bones in the formation of the protector shield, as well as their light weight, allow the chest wall to expand during breathing. Also, if one part of the chest wall bone fractures, it does not affect the other parts.[6] Figure 1 illustrates the anatomy of the skeleton which is attributed to Avicenna.

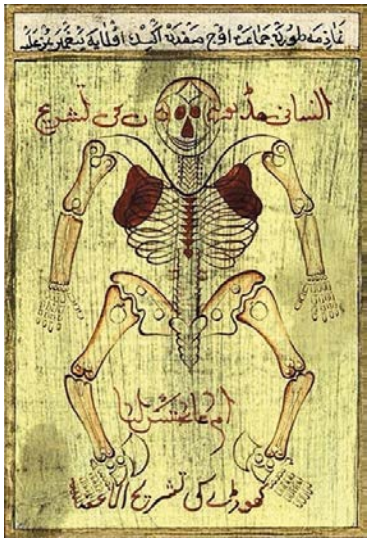

Figure 1.

He believed that the seven true ribs are fractured at both sides, while this occurs to the false ribs at their medial side. Then, he explained the physical examination to diagnose the broken ribs. The examination included inconsistency in

[6] Ibn-Sina (1991) Al-Qanun Fit-Tibb. Translated by Abdurrahman Sharafkandi. Tehran: Soroush.

the palpation of the ribs and abnormal movement in the ribs in respiration. Also, low sounds caused by moving the broken edge of the ribs could be heard

> *"the true ribs may fracture from both sides but false ribs only get fractured from the part which is near to heart because the other side is cartilaginous (karkarak) which is near abdomen. These cartilaginous parts do not get fractured but they may get smashed. The rib fractures can get detected by palpation which has stepping and movement in abnormal place."*

Avicenna also demonstrated the complications of the ribs fractures as the broken ribs penetrate into the underling organs causing *Zat al janb*, which means pleural layer injury. It could also present with hemoptysis.[7]

He believed that in the case of the rib bone fracture, the best strategy for its management was to use a cupping glass called *baad kesh*, (means vacuum), in order to induce a local negative pressure on the chest wall. This instrument helped physicians to put the fractured ribs back to their place. Also, it was mentioned that if the patient's condition deteriorated while using *baad kesh*, an open surgery should be done to manage *Zat al janb*, which probably means tension pneumothorax.[8]

> *"you should not be hurried for traction and reduction of the fractured ribs. Elevation the fractured ribs without using baad kesh is very hard. On the other hand, using baad kesh may lead into accumulation of unfavourable and irritating material at the site of fracture. If you use baad kesh gently and they do not remain in one site for long time, there is no problem with using it. However, you should not only rely on baad kesh. And give the patient flatulence food so their abdomen gets inflated and force the fractured ribs to outside. Although using flatulence food is essential sometimes, it can be harmful. "*

He demonstrated that if the ribs penetrated into the pleura, the mentioned ribs should be cut and removed with a surgical procedure. He also recommended putting a protector under the fractured ribs during the procedure to avoid further pleural injuries. He believed that if the site of injury developed with warm oedema, the site of surgery should not get closed.[9]

---

7 Ibid.
8 Ibid.
9 Ibid.

Avicenna quoted in his book a bonesetter as below:

> *"You should cover the broken bone with a wool cloth dipped into warm olive oil and place the paddings between the ribs to fill the gaps, so when you wrap the body with a bandage, it stays on a flat surface. As explained in the treatment of patients with fractured ribs, wrap the bandage around the body, as you do with patients with swelling of the cover of the ribs, which is to be appropriate to the fractured ribs. If the fractured ribs were stiff to be returned to its place and the fractured part contacted with the hejab (pleura) and irritated it, you have to remove the skin to reach the fractured part, then put the sefagh (peritoneum) protector tool under the ribs to prevent the peritoneum from coming out. Slowly remove the part of the fractured rib that contacts the diaphragm and hurt it. Then, if no hot swelling occurred, close the gaps and apply balms. But, if hot swelling occurred, soak the paddings in the proper oil and apply them on the wound and give the patient medications and foods that soothe the swelling. Also, let the patient sleep on the side that is less painful."*

He recommended the use of flatulence food in order to increase the abdominal pressure from the inside to better reduce the broken ribs. However, he mentioned that this method had some side effects. He also recommended wrapping the involved ribs with special materials in order to fix them.[10]

Discussion

The most common ribs fractures occur at their anterolateral and posterolateral parts, followed by the cartilaginous part of the ribs. Currently, most of the ribs fractures are caused by traffic accidents that exert great pressure on the ribs and fracture them at the ribs curvature, which is a dynamic weak point of the ribs. Also, the cartilage fractures are easily missed because today broken cases are usually diagnosed based on radiologic findings and due to the fact that cartilage fractures are invisible in such methods.[11] This is why Avicenna stated that the cartilaginous parts of the ribs are smashed by trauma instead of getting fractured.

Currently, invasive approach toward ribs fractures is not common because it seems that such interventions do not reduce pain or the hospitalization

---

10 Ibid.

11 Turk F, Kurt AB, Saglam S. (2010), Evaluation by ultrasound of traumatic rib fractures missed by radiography, Emergency radiology, 17 (6): 473-7.

time.[12] Except for the flail chest cases with respiratory failure, these patients cannot be extubated from the ventilator.[13] Avicenna's idea regarding using vacuum in replacing the fractured ribs should be taken into account, since patients with displaced broken ribs usually suffer from discomfort in respiration and they have to take more sedatives to relieve the pain. Rib reduction in these patients could probably help them to reduce these complaints; thus, further studies should be conducted on this issue.

Furthermore, another considerable point in the statements of Avicenna is the fixation of the deformed parts of the chest wall. During the last decades, it was common to reduce the separated segment of the flail chest and fix it. However, in recent times, the professionals' approaches have been against invasive intervention except for the aforementioned complications. It seems that this may accelerate the healing process and decrease the pain.[14] The warm oedema which may occur at the site of surgery could be perceived as signs of infection, and his recommendation to keep such wounds open is similar to the conventional approach toward dirty wounds.[15]

Using flatulence food is not applicable in conventional medicine, but the concept of increasing intra-thoracic pressure is one of the therapeutic interventions that are currently used, especially for patients with flail chest and respiratory failure. This pressure is provided by positive pressure ventilation and leads to internal fixation of the ribs.[16]

Present study was a review of Avicenna's viewpoints on the ribs anatomy and the management of their fractures. His statements should be assessed with regard to his time in the right historical context.

Acknowledgements:

The authors would like to thank Shiraz University of Medical Sciences, Shiraz, Iran and also Center for Development of Clinical Research of Nemazee Hospital and Dr. Nasrin Shokrpour for editorial assistance.

---

12 Martin R, Lawless B, Henry PD, Nauth A. (2015), Complications of Surgical Treatment and Their Management, Injuries to the Chest Wall: Springer; p. 131-41.

13 Tarng Y-W, Liu Y-Y, Huang F-D, Lin H-L, Wu T-C, Chou Y-P. (2015), The surgical stabilization of multiple rib fractures using titanium elastic nail in blunt chest trauma with acute respiratory failure, Surgical endoscopy, 1-8.

14 Nirula R, Mayberry JC. (2010), Rib fracture fixation: controversies and technical challenges, The American surgeon, 76 (8): 793-802.

15 Fabricant L, Ham B, Mullins R, Mayberry J. (2013), Prolonged pain and disability are common after rib fractures, The American Journal of Surgery, 205 (5) :511-6.

16 Shah M. (2015), To intubate or not to intubate–management of multiple rib fractures, Trauma, 17 (4): 299-302.

References

1. Bemelman M, Long W, Mayberry J. (2018), History of rib fracture management. Rib Fracture Management: Springer; p. 1-24.
2. Fabricant L, Ham B, Mullins R, Mayberry J. (2013), Prolonged pain and disability are common after rib fractures, The American Journal of Surgery, 205 (5): 511-6.
3. Goodrich JT. (2004), History of spine surgery in the ancient and medieval worlds, Neurosurgical focus, 16 (1): 1-13.
4. Ibn-Sina (1991), Al-Qanun Fit-Tibb, Translated by Abdurrahman Sharafkandi, Tehran: Soroush.
5. Martin R, Lawless B, Henry PD, Nauth A. (2015), Complications of Surgical Treatment and Their Management, Injuries to the Chest Wall: Springer; p. 131-41.
6. Mazengenya P, Bhikha R. (2018), revisiting Avicenna's (AD 980–1037) anatomical concepts of the musculoskeletal and peripheral nervous systems in the Canon of medicine. Acta medico-historica Adriatica, 16 (2): 267-82.
7. Nirula R, Mayberry JC. (2010), Rib fracture fixation: controversies and technical challenges, The American surgeon, 76 (8): 793-802.
8. Shah M. (2015), To intubate or not to intubate–management of multiple rib fractures, Trauma, 17 (4): 299-302.
9. Siraisi NG. (2014) Avicenna in Renaissance Italy: The Canon and medical teaching in Italian universities after 1500, Princeton University Press.
10. Tarng Y-W, Liu Y-Y, Huang F-D, Lin H-L, Wu T-C, Chou Y-P. (2015), The surgical stabilization of multiple rib fractures using titanium elastic nail in blunt chest trauma with acute respiratory failure, Surgical endoscopy, 1-8.
11. Turk F, Kurt AB, Saglam S. (2010), Evaluation by ultrasound of traumatic rib fractures missed by radiography, Emergency radiology, 17 (6): 473-7.
12. Usmanova R. (1980), Avicenna on the musculoskeletal system, Arkhiv anatomii, gistologii i embriologii, 79 (9): 112-4.

Sažetak

Uvod: U svom remek-djelu Canon u Tibbu *Avicena je iznio zanimljiva gledišta vazana uz simptome prijeloma rebrenih kostiju i njihov fizički pregled te liječenje komplikacija.*

Metoda: Donosimo pregled Avicenina Canona *i njegova pogleda na anatomiju rebrenih kostiju i njihove prijelome i uspoređujemo ih s konvencionalnom medicinom.*

Rezultat: Avicena je opisao anatomiju rebara; objasnio je djelotvornost njihove strukture u zaštiti vitalnih organa. Predložio je i neke od metoda za liječenje prijeloma rebara poput upotrebe vakuuma na mjestu prijeloma ili otvorene operacije u slučaju komplikacija.

Zaključak: Avicenin pogled na pristup liječenju prijeloma rebara imao je neke sličnosti i razlike s konvencionalnom praksom. Neka od njegovih razmišljanja mogu se i danas uzeti u obzir.

Ključne riječi: *Avicena; anatomija rebara; prijelom rebara; prava rebra; lažna rebra, Kanon medicine*