INTERNATIONAL JOURNAL OF NETWORKS AND SECURITY

ACADEMIC PUBLISHERS

INTERNATIONAL JOURNAL OF NETWORKS AND SECURITY (ISSN: 2693-387X)

Volume 04, Issue 01, 2024, pages 44-48
Published Date: - 30-11-2024
DOI: - https://doi.org/10.55640/ijns-04-01-08

# DEVELOPMENT OF CARDIAC DYSFUNCTION IN MILITARY PERSONNEL WITH CHRONIC VS ACUTE INCREASES IN INTRA-ABDOMINAL PRESSURE

**Farida Azizova**
Center for Development of Professional Qualification of Medical Workers, Tashkent, Uzbekistan

## Abstract

This study examines the development of cardiac dysfunction in military personnel with chronic versus acute increases in intra-abdominal pressure (IAP). Intra-abdominal hypertension (IAH) has been associated with significant cardiovascular complications, including impaired myocardial function and hemodynamic instability. The study compares two groups of military patients—those with chronic IAP elevations, often due to repeated abdominal trauma or surgeries, and those with acute IAP increases following traumatic injuries or emergency surgeries. Using a retrospective cohort design, we assessed cardiovascular parameters, including cardiac output, myocardial contractility, and central venous pressure, in both groups. Additionally, we evaluated the incidence of multi-organ dysfunction and the impact on mortality. Our findings suggest that chronic increases in IAP result in gradual deterioration of myocardial function, with a higher incidence of sustained cardiac dysfunction and complications such as arrhythmias and heart failure compared to acute increases in IAP. In contrast, acute increases in IAP, although leading to transient myocardial dysfunction, showed a higher degree of hemodynamic instability and a more severe impact on organ function in the immediate post-trauma or post-surgery period. The study highlights the importance of early recognition and management of elevated IAP in military settings, emphasizing that both chronic and acute elevations pose distinct challenges to cardiovascular health. Timely intervention, including non-invasive monitoring and pharmacologic treatment, is essential to prevent irreversible cardiac damage and improve survival outcomes in military personnel exposed to high-risk environments.

## Keywords

intra-abdominal pressure, cardiac dysfunction, military personnel, chronic IAP, acute IAP, myocardial function, hemodynamic instability, intra-abdominal hypertension, multi-organ dysfunction, trauma, cardiovascular health, non-invasive monitoring, pharmacologic treatment, survival outcomes.

## INTRODUCTION

Intra-abdominal hypertension (IAH) is a condition characterized by an elevated intra-abdominal pressure (IAP) greater than 12 mmHg, which has been associated with significant cardiovascular complications, including impaired myocardial function, hemodynamic instability, and multi-organ dysfunction. Military personnel are particularly vulnerable to elevated IAP due to the nature of their injuries, which often involve traumatic abdominal injuries or complex surgical procedures. In these high-risk environments, the occurrence of chronic versus acute increases in IAP may lead to distinct physiological outcomes. Chronic IAP elevations are often seen in military personnel with repeated abdominal trauma or surgeries, while acute IAP increases occur in the context of severe, sudden injuries such as gunshot wounds or blast trauma. This study aims to explore the differences in the development of cardiac dysfunction between military patients with chronic and acute increases in IAP.

Methodology

A retrospective cohort study was conducted using medical records from military personnel who sustained abdominal trauma or underwent abdominal surgeries between 2015 and 2020. The study included two groups: one consisting of patients with chronic IAP elevations, and the other with acute increases in IAP. Patients with chronic IAP were those who had a history of recurrent abdominal trauma or multiple surgeries that led to sustained IAP increases, while the acute group consisted of patients who experienced a sudden rise in IAP following a traumatic event or emergency surgery. Inclusion criteria for both groups required that patients had IAP measurements greater than 12 mmHg, which were recorded via bladder pressure measurement or clinical monitoring methods.

The primary objective of the study was to assess the impact of chronic and acute IAP on myocardial function. We focused on parameters such as cardiac output, myocardial contractility (as measured by echocardiography), and central venous pressure (CVP). Additionally, the study examined the incidence of multi-organ dysfunction (MOD) and the associated impact on mortality. A comparison between the two groups was made to identify differences in the onset and severity of cardiac dysfunction, as well as the clinical outcomes related to IAP elevations.

Results

A total of 150 military personnel met the inclusion criteria for this study, which aimed to investigate the impact of intra-abdominal pressure (IAP) on cardiovascular function and organ dysfunction in military patients. Of these, 70 patients (46.7%) were classified as having chronic IAP elevations, while the remaining 80 patients (53.3%) experienced acute IAP increases. The chronic IAP group consisted of patients who had sustained abdominal trauma from previous military operations (60%) or had undergone multiple abdominal surgeries (40%). These individuals often experienced prolonged elevations in IAP due to repeated trauma or surgical interventions. In contrast, the acute IAP group included patients who had sustained penetrating trauma (45%) or blunt trauma (55%), with the majority requiring urgent laparotomies to manage their injuries. The distinction between chronic and acute IAP groups allowed for a comparative analysis of the long-term versus immediate effects of elevated IAP on cardiovascular and organ function.

Hemodynamic Changes

Significant differences were observed in the hemodynamic parameters between the chronic and acute IAP groups. In the chronic IAP group, 65% of patients demonstrated a gradual decline in cardiac output over time. This reduction in cardiac output, a key marker of myocardial dysfunction, was indicative of the long-term consequences of sustained elevated IAP. Furthermore, 55% of patients in this group exhibited persistent myocardial dysfunction, as evidenced by echocardiographic findings. Myocardial contractility was significantly reduced in 50% of these patients, suggesting a chronic impact on heart function due to prolonged intra-abdominal hypertension.

In contrast, the acute IAP group exhibited more pronounced hemodynamic instability in the immediate post-trauma period. Cardiac output was reduced in 75% of patients within the first 24-48 hours of injury or surgery, a significant increase compared to the chronic IAP group. Of these patients, 65% displayed marked myocardial dysfunction, indicating that acute increases in IAP lead to a rapid decline in myocardial performance. Additionally, the increase in central venous pressure (CVP) was more pronounced in the acute IAP group, with 70% of these patients showing signs of impaired venous return. Elevated CVP is a hallmark of reduced venous return due to increased IAP, further exacerbating the reduction in cardiac output and contributing to hemodynamic instability.

Multi-Organ Dysfunction

The incidence of multi-organ dysfunction (MOD) was significantly higher in the acute IAP group. Of the patients with acute IAP, 80% developed at least one organ failure, which is a stark contrast to the 50% of patients in the chronic IAP group who developed MOD. Renal failure was the most common complication in both groups, affecting 60% of patients in the chronic IAP group and 70% in the acute IAP group. Elevated IAP impairs renal perfusion by compressing the renal vasculature, leading to acute kidney injury. The increased incidence of renal failure in the acute IAP group may be attributed to the rapid and severe nature of the IAP increases, which more acutely affect organ function.

Respiratory distress was also more common in the acute IAP group, with 35% of these patients requiring mechanical ventilation due to compromised lung function. In contrast, 20% of patients in the chronic IAP group experienced respiratory complications. The mechanical effects of elevated IAP on the diaphragm and chest cavity reduce lung compliance, impeding normal respiratory function. This is particularly concerning for military personnel, who may already be at risk for respiratory compromise due to trauma and other injuries.

Cardiac instability, including arrhythmias and hypotension, was observed in 20% of patients with chronic IAP and in 25% of those with acute IAP. The elevated pressure within the abdominal cavity impedes venous return to the heart, leading to low blood pressure and tachycardia as the body attempts to compensate for reduced perfusion. In

severe cases, this results in arrhythmias that can further complicate the patient's condition. The presence of cardiac instability in both groups underscores the systemic impact of IAP on multiple organ systems.

Mortality Rates

The mortality rates were significantly higher in the acute IAP group. Twenty percent of patients with acute IAP died during their hospital stay, compared to just 8% in the chronic IAP group. This stark difference in mortality rates highlights the immediate and severe impact of acute increases in IAP on patient survival. In military settings, where patients often face complex trauma and limited medical resources, early recognition and management of elevated IAP are crucial to improving survival outcomes. The increased mortality in the acute IAP group is likely due to the rapid onset of IAH and its associated complications, such as cardiovascular instability and multi-organ failure.

ICU Stay and Healthcare Utilization

Patients with acute IAP also required significantly longer stays in the intensive care unit (ICU) compared to those with chronic IAP. On average, patients with acute IAP required 12 additional days in the ICU, reflecting the increased complexity of care needed to stabilize these patients. The prolonged ICU stay was associated with higher healthcare resource utilization, including the need for mechanical ventilation, renal replacement therapy, and continuous monitoring. In contrast, patients with chronic IAP required an average of 6 additional days in the ICU, suggesting that while chronic IAP is associated with long-term complications, the acute onset of IAH is more resource-intensive and requires more immediate and intensive care.

Surgical Interventions

Surgical interventions, particularly decompressive laparotomies, were performed in 50% of the patients in both the chronic and acute IAP groups. Decompressive laparotomy, which involves the surgical release of pressure within the abdominal cavity, was effective in improving both hemodynamics and myocardial function in the patients who underwent the procedure. After decompression, patients showed significant reductions in IAP, improved cardiac output, and stabilization of central venous pressure. The improvements in myocardial function and hemodynamics following decompressive surgery further emphasize the importance of early intervention in patients with elevated IAP. However, while decompressive laparotomy is an effective treatment, it should not be the first-line intervention. Early identification and non-invasive monitoring of IAP are essential to prevent the progression of IAH to more severe stages, such as abdominal compartment syndrome (ACS).

**Detailed Results of Study on Intra-Abdominal Hypertension in Military Personnel**

| Category | Details |
|---|---|
| Total Patients | 150 |
| Chronic IAP Group | 70 (46.7%) |
| Acute IAP Group | 80 (53.3%) |
| Cardiac Output Reduction (Chronic) | 65% |
| Cardiac Output Reduction (Acute) | 75% |
| Myocardial Dysfunction (Chronic) | 55% |
| Myocardial Dysfunction (Acute) | 65% |
| CVP Increase (Chronic) | 50% |
| CVP Increase (Acute) | 70% |
| Multi-Organ Dysfunction (MOD) (Chronic) | 50% |
| Multi-Organ Dysfunction (MOD) (Acute) | 80% |
| Renal Failure (Chronic) | 60% |
| Renal Failure (Acute) | 70% |
| Respiratory Distress (Chronic) | 20% |
| Respiratory Distress (Acute) | 35% |
| Cardiac Instability (Chronic) | 20% |
| Cardiac Instability (Acute) | 25% |
| Mortality Rate (Chronic) | 8% |

| | |
|---|---|
| Mortality Rate (Acute) | 20% |
| ICU Stay (Chronic) | 6 Days |
| ICU Stay (Acute) | 12 Days |
| Surgical Interventions (Decompressive Laparotomy) | 50% |

**DISCUSSION**

The findings of this study suggest that chronic and acute increases in intra-abdominal pressure are associated with significant cardiovascular dysfunction in military personnel. However, there is a significant difference in the nature and magnitude of the effects of chronic versus acute IAP increases. The chronic IAP, such as that occurring due to repeated abdominal trauma or multiple surgeries, tends to have a progressive and long-lasting effect on myocardial function. The cumulative stress imposed on the cardiovascular system over time likely explains the persistent reductions in cardiac output and myocardial contractility seen in patients with chronic IAP. Long-term effects are particularly worrisome in military personnel who may be exposed to multiple abdominal traumas or surgeries, thus further compromising cardiovascular function. Chronic IAP causes progressive deterioration of the myocardial tissue, which later becomes more susceptible to further injury or insult.

On the other hand, acute increases in IAP are associated with more immediate and severe effects on hemodynamic stability. An abrupt rise in IAP, often caused by traumatic injury or emergency abdominal surgery, causes impedance to venous return with severe impairment of cardiac output. This may impose a huge burden on the heart, thereby exacerbating hemodynamic instability and provoking the rapid development of shock. Acute IAP has also been implicated in disruption to myocardial function. It has led to extremely highly significant depression of the myocardial contractility obtained from the results of this study. Since increased IAP reduces effective venous return to the heart, it diminishes the heart's ability to pump effectively and maintain blood pressure to sustain tissue perfusion. Acute alterations predispose one toward multi-organ dysfunction, with a special interest in renal and pulmonary systems. These are the common complications of IAH due to the elevated pressure compressing abdominal organs such as the renal vasculature and the diaphragm, essential to normal respiratory and renal function.

The most disturbing finding in this study was the significantly higher mortality rate in the acute IAP group. Patients in this group demonstrated a 20% mortality rate compared with only 8% in the chronic IAP group. The acute IAP group showed rapid deterioration, and such a condition needs to be managed with a lot of urgency in military settings. Trauma and critical abdominal surgeries are high in such environments, and acute IAP could be disastrous if not timely addressed. Acute IAP can result in irreversible organ damage in critically high-risk patients with no intervention on time. The prevention of these complications, therefore, requires early detection of increased IAP and prompt medical intervention. The high mortality rate in the acute IAP group underlines the importance of early diagnosis and treatment in order to minimize the risks associated with IAH. On the other hand, chronic IAP, though harmful over time, presents with a slower progression of symptoms, allowing for more gradual intervention.

It also seemed efficient for the treatment of intra-abdominal hypertension both at chronic and acute stages. Decompressive laparotomy improved the patients' hemodynamic stability, including myocardial function, thereby enhancing short-term survival by minimizing direct risks from IAH. These findings, however, showed that a surgical decompression technique could not be the first line treatment technique for IAH. Although it is still an important option in severe situations, the study shows that routine monitoring of IAP, especially within the first 48 hours after trauma or surgery, should be done. The early intervention of reducing IAP with the use of pharmacological agents, optimized fluid management, and non-invasive monitoring methods in patients should be done to prevent the progression into abdominal compartment syndrome (ACS) or multi-organ failure. IAP can be monitored non-invasively by the measurement of bladder pressure, which is effective and feasible even in resource-constrained military settings.

Furthermore, given the nature of their activities that predisposes personnel to traumatic injuries and necessitates complex abdominal surgeries, early signs of elevated IAP should be taught to medical personnel in the military setting. Given the nature of combat-related injuries and challenges with the provision of care in austere environments, early detection of IAH is critical to improving outcomes. Monitoring of IAP through standardized methods, one of which is bladder pressure measurements, should be included in the routine clinical practice of military healthcare providers. Furthermore, frequent monitoring of cardiac output and CVP for hemodynamic parameters can lead to the early detection of cardiovascular compromise and thus provide timely intervention before irreversible changes take

place.

Besides non-invasive monitoring, other early medical interventions include fluid management and the use of pharmacologic agents to stabilize hemodynamics, all of which play a significant role in preventing the deterioration of IAH. Optimal management of such complications related to IAP is related to abdominal compartment syndrome and multi-organ dysfunction, supported by timely medical and surgical interventions within a multidisciplinary approach. Minimal-volume ventilation strategies can further support respiratory function in patients with elevated IAP, thereby reducing the burden on the respiratory system and preventing the need for mechanical ventilation. The results of this study emphasize the need for uniform protocols in military healthcare settings regarding monitoring and managing IAP.

These protocols should be designed to provide consistent, real-time assessments of IAP, particularly during the critical 48-hour post-trauma or post-surgery window. Therefore, timely interventions to decrease high IAP will further promote better clinical outcomes and improved mortality rates among military personnel and reduce the drain on health care resources.

Impact on Health-Care Resources In light of the above points, proper management of IAH among the military could ease pressure on their health resources in theatre. Military operations are very common in combat areas, usually with very limited numbers of either beds or personnel in an Intensive Care Unit setting.

Early detection and timely intervention prevent more invasive procedures, such as decompressive laparotomies, and shorten stays in the ICU, which are often prolonged by complications involving IAH.

This would mean that minimizing surgical interventions and reducing the need for ICU care would allow military healthcare systems to divert resources to other critical care needs, especially during times of high combat activity or during medical emergencies. Moreover, by preventing IAH from progressing to the more advanced stages, health professionals are able to provide an overall good prognosis for military personnel to return to duty in shorter periods with minimal long-term complications.

## CONCLUSION

This study confirms that both chronic and acute increases in intra-abdominal pressure lead to significant cardiac dysfunction and multi-organ complications in military personnel. The acute rise in IAP is associated with more severe and immediate hemodynamic instability, while chronic IAP results in gradual myocardial dysfunction. Early detection and intervention, particularly within the first 48 hours of trauma or surgery, are essential to improve outcomes and reduce mortality. Non-invasive monitoring of IAP, combined with appropriate pharmacologic and surgical interventions, should be prioritized in military medical settings to manage this critical condition effectively. The findings emphasize the need for standardized protocols for monitoring and managing IAP in military personnel, ultimately improving patient outcomes and the efficiency of military healthcare systems.

## REFERENCES

1. Al-Mujadi, T., et al. (2019). Intra-abdominal hypertension and its impact on organ dysfunction: A review. Journal of Trauma and Acute Care Surgery, 87(5), 900-905.
2. Behrens, H., et al. (2018). Management of intra-abdominal hypertension in trauma patients. Trauma Surgery & Acute Care Open, 3(1), e000176.
3. Hughes, C. M., et al. (2020). Clinical outcomes of intra-abdominal hypertension in military patients. Military Medicine, 185(3-4), 123-130.
4. Roubik, D. W., et al. (2021). Abdominal trauma and compartment syndrome: The military experience. Journal of Trauma, 88(2), 234-240.