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Upper extremity blood flow changes in professional baseball pitchers between two consecutive seasons

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Background: Because of the tremendous forces produced and the repetitive nature of baseball, players have shown various shoulder adaptations in strength and range of motion. However, no research has identified whether alterations occur in the blood flow to the dominant arm among competitive baseball players.
Methods: Twenty professional baseball pitchers and 16 position players participated. Measurements were taken on day 1 of 2 consecutive spring training seasons. Diagnostic ultrasound was used to measure blood flow of the throwing arm brachial artery. These measurements were taken in a standing position with the test arm resting at the participant's side and again with the test arm in a provocative shoulder position. Separate 1-way analyses of variance were conducted to compare blood flow between seasons ($P < .05$).
Results: In a resting position, the blood flow of the pitchers did not change from 1 year to the next ($P = .48$). However, blood flow of the pitchers in the provocative position significantly decreased after the first year ($P = .009$). The position players did not have any significant changes in blood flow for either arm position ($P > .11$).
Conclusions: In a provocative shoulder position, the blood flow of pitchers significantly decreased after 1 competitive baseball season. These results indicate that after a competitive season, the blood flow to the upper extremity of pitchers may be compromised.
Level of evidence: Basic Science Study, Physiology.

Keywords: Prospective; throwing athlete; upper extremity; vasculature

Baseball players have a high incidence of shoulder disease, such as damage to the capsule, ligaments, muscles, and labrum. More recently, perhaps as a result of raised awareness, there has also been an increased recognition of neurovascular pathologic changes in the upper extremity among these athletes.[22] In fact, Duwayri et al[12] reported that baseball players constitute 70% of individuals diagnosed with symptomatic vascular compression in overhead athletes. The ballistic and repetitive nature of baseball that causes various adaptations of the static and dynamic shoulder restraints may cause similar alterations of the

This study was approved by the Illinois State University Institutional Review Board: No. 2012-0006. All participants provided informed consent before data collection.

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Table I Descriptive participant demographics

Group	Age (years)	Height (cm)	Mass (kg)	Professional baseball experience (years)
Pitchers	22.1 ± 1.5	188.2 ± 6.6	94.3 ± 10.1	2.8 ± 1.5
Position players	21.4 ± 2.2	182.2 ± 3.0	89.9 ± 5.8	2.6 ± 1.9

upper extremity vascular tissue. As forces accumulate from 1 competitive season to the next, such alterations may ultimately result in damage to the proximal artery and subsequent ischemia and time lost from competition.[15] As such, an improved understanding of these potential adaptations may aid in the prevention, diagnosis, and treatment of vascular pathologic processes among baseball players.

Baseball players, primarily pitchers, are largely susceptible to the development of various chronic adaptations that can lead to upper extremity vascular occlusion. More specifically, increased anterior glenohumeral laxity,[4] pectoralis minor tightness,[10,18] and scalene tightness[10,18] have been associated with compression of the upper extremity vascular and nervous tissue. Baseball players with symptomatic neurovascular occlusion often initially complain of arm fatigue or feeling of a heavy arm as well as loss of ball control and velocity.[1,3,15,21,24] This sensation has been termed dead arm syndrome[23] and is notoriously used for various diagnoses among baseball players.[4,6,23] Unfortunately, because these early symptoms are commonly nonspecific and routinely found in throwers, true pathologic changes attributable to the cause of such symptoms often go undetected until more significant vascular or neurologic compression and damage occur.[12] As this occlusion continues or the compressive force increases, complaints may be manifested into dull pain, paresthesia, and physical signs such as swelling, discoloration, cold skin, decreased strength, and even fingertip ulcers.[2,7,12,15,20,24]

Numerous adaptations have been identified in the throwing shoulders of baseball players, such as range of motion,[9,28] strength,[9,19] glenohumeral laxity,[5] and scapular kinematics.[16,28] However, no research has identified whether baseball players have any chronic vascular changes secondary to throwing. Thus, the purpose of this study was to determine if blood flow among pitchers and position players changes after a competitive baseball season. We hypothesized that the accumulation of stress from repetitive throwing would result in pitchers' having decreased upper extremity blood flow after a competitive season.

Materials and methods

Subjects

Twenty professional baseball pitchers and 16 position players volunteered to participate in this study (Table I) None of the participants had any recent history (past 6 months) of upper extremity injury or any upper extremity surgery.

Figure 1 Provocative test shoulder position.

Procedures

This was a prospective cohort study that examined whether the blood flow of pitchers and position players changed after a competitive baseball season. Each participant voluntarily attended 2 testing sessions that were conducted on day 1 of 2 consecutive spring training seasons (2013 and 2014) for a professional baseball organization. All testing was completed by the same investigators who were blinded to the position played by each participant. All testing occurred on the first day of spring training during the players' physical examinations. Therefore, no testing was performed after an extensive throwing or strength training session.

Brachial artery blood flow was recorded in the throwing arm of each participant using a Terason t3000 M-series ultrasound system (Teratech, Burlington, MA, USA). This measurement was conducted during 2 test arm positions. For each position, the participant was standing and the ultrasound head was placed over the brachial artery to determine blood flow. The first position was conducted with the test arm resting at the participant's side (approximately 0° of shoulder abduction). The second position was administered with the test arm in a provocative position