

IATROGENIC AND NONIATROGENIC ARTERIAL TRAUMA: A COMPARATIVE STUDY

Miltos K. Lazarides, Anastasios C. Liatas, Dimitrios P. Arvanitis and John N. Dayantas

From the Department of Vascular Surgery, Athens General Hospital, Greece

Abstract. During a 6 - year period 22 patients were operated on because of iatrogenic arterial trauma (group A) and 43 sustained noniatrogenic arterial injury (group B). The group A injuries were caused by various arterial catheterization procedures for angiography or cardiac investigation (55%) or surgical interventions (45%). Haemorrhage was more common in group B than in group A ($p < 0.001$). The mortality rate did not differ significantly between the groups (14% vs. 9%). Permanent disability was more common in group B ($p < 0.05$), due mainly to higher incidence of associated venous, neural, skeletal or visceral injuries. Bypass operations tended to be more often performed in group B than in group A, but the difference was not statistically significant. Retrospective assessment of the appropriateness of technique, made separately by two vascular surgeons, revealed instances of potentially avoidable iatrogenic arterial injury. The rising incidence of iatrogenic arterial trauma may therefore be considered 'reducible'.

Key words: arterial injury, iatrogenic injury.

Iatrogenic arterial trauma may arise in diagnostic or therapeutic procedures (Gr. *ιατρός* = physician, *γεννώ* = give birth to). The incidence of reported iatrogenic arterial trauma has clearly risen in recent years, as a result of the dramatically increased performance of cardiac catheterization and angiography, or of the increasingly radical operations now performed for a variety of lesions in all surgical fields.

MATERIAL AND METHODS

In the 6-year period 1984-1989, 22 patients were operated on at our Department of Vascular Surgery because of iatrogenic arterial injury (group A). Perioperative arterial injuries during vascular procedures that were immediately corrected by the surgical team or ligated isolated injury to the radial, ulnar or a tibial artery were not included in this study. The mean age (± 1 SD) of these patients (13 men, 9 women) was 56 ± 12 (range 39-80) years. The records of 43 patients treated for noniatrogenic arterial trauma during the same period (group B) were reviewed. All but three were men and the mean age was 35 ± 15 (16-80) years.

In an attempt to assess faulty surgical technique as a possible cause of the iatrogenic injuries, two vascular surgeons independently reviewed each of the 22 cases, using a scale from 0 to 4, with 0 = obvious fault, e.g. ligation of the superficial femoral artery during varicose vein surgery and 4 for unavoidable injury, e.g. delayed arterial damage due to

migration of a metallic wire 5 years after total hip arthroplasty.

χ^2 statistical analysis (with Yates' correction) was employed to evaluate surgical mortality (within 30 days after operation) and postoperative major permanent disability (amputation, nerve palsy, symptomatic ischaemia or functional impairment of a limb due to postphlebotic state or muscle loss) in both groups.

RESULTS

Rising incidence of iatrogenic arterial injury was found during the 6-year study period, i.e. from 12% of all arterial injuries in 1984 to 58% in 1989 (Fig. 1). The distribution of injury location differed between the iatrogenic and the noniatrogenic group (Table I). Iatrogenic arterial trauma occurred in association with vascular puncture, mostly during cardiac catheterization, or surgery (Table II). The average score given by each one of the two vascular surgeons concerning appropriateness of technique in the individual cases was 2.4 ± 1.1 and 2.2 ± 1.1 (± 1 SD) respectively. In the noniatrogenic group the causes of injury were blunt trauma (motor vehicle accident or fall) in 24 cases, stab wound in 12 and gunshot wound in six cases. In the remaining case there was a false aneurysm due to femoral artery puncture by a heroin addict. The clinical presentation differed between the groups (Table III).

No significant intergroup difference was found in the incidence of false aneurysm, arteriovenous fistula formation or ischaemia, but significantly more patients in the noniatrogenic group presented with haemorrhage ($p < 0.001$). The types of vascular repair employed (Table IV) did not differ significantly between groups A and B. In addition to the arterial trauma, 29 of the 43 group B patients simultaneously sustained venous, neural, skeletal and/or visceral injury and underwent a total of 37 nonarterial operations. Only four of the 22 group A patients had coexistent venous injury. The incidence of associated injuries was significantly ($p < 0.001$) lower in group A than in group B. The postoperative mortality did not differ significantly between groups A and B (14% and 9%, respectively). The three deaths in group A were

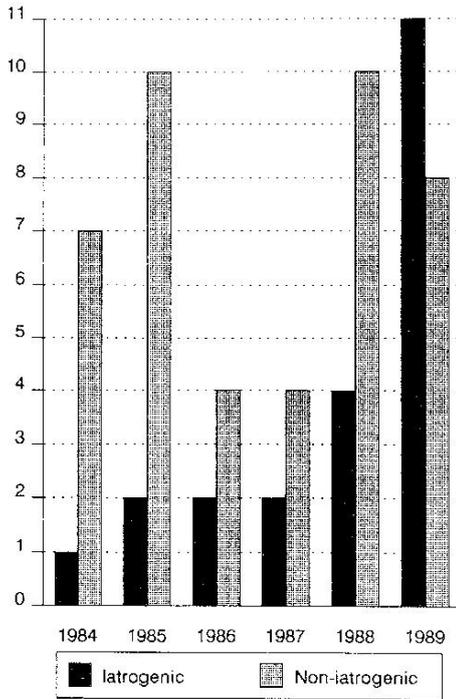


Fig. 1. Iatrogenic and noniatrogenic arterial trauma during the study period.

due to circulatory and renal failure (2 cases) or massive pulmonary embolism (1 case), and the four deaths in group B to septic shock (3 cases) and disseminated intravascular coagulation and bleeding following repair of abdominal aortic trauma (1 case). Permanent disability was sustained by 11 (26%) of the group B patients, but none in group A ($p < 0.05$). The causes of disability were nerve palsy (5 cases), postphlebotic leg (2), intermittent claudication (2),

Table I. Location of iatrogenic and noniatrogenic arterial injuries

Injured arteries	Iatrogenic		Noniatrogenic	
	No.	%	No.	%
Carotid	1	4.5	2	4.6
Axillary	0		5	11.6
Brachial	10	45.4	6	13.9
Radial + ulnar	0		6	13.9
Abdominal aorta or branches	1	4.5	2	4.6
Iliac	3	13.6	2	4.6
Femoral	6	27.2	7	16.2
Popliteal or tibio-peroneal trunk		4.5	13	30.2
Total	22	100	43	100

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Table II. Aetiology of iatrogenic arterial trauma

Arterial puncture	n	Surgical procedure	n
Cardiac catheterization	10	Hip surgery	3
Angiography	1	Knee surgery	1
Puncture of arteriovenous graft	1	Lower anterior resection	2
		Gastrectomy	1
		Radical neck dissection	1
		Embolectomy	1
		Varicose veins surgery	1
Total	12		10

major amputation (2) and severe muscle loss (2), with more than one cause in two cases.

DISCUSSION

Although iatrogenic arterial trauma is a well defined clinical entity, its reported incidence in relation to total numbers of arterial injuries varies from 1.4 to 76% (1, 3, 8, 9, 11). In our study, 34% of the arterial injuries were iatrogenic. As some cases of iatrogenic arterial injury are not reported for fear of legal consequences, no clear picture of the problem's size is obtainable. Most authors nevertheless report increasing numbers of iatrogenic arterial injuries, attributed mainly to rise in the number of cardiac catheterizations and the modern tendency to perform radical surgery for a variety of lesions (3, 8). In our Department, a twofold increase in cardiac catheterizations during the second half of the study period was a major contributor to the corresponding increase of iatrogenic arterial trauma.

The arteries of the extremities were most often affected - brachial and femoral, the commonest sites of arterial puncture in the iatrogenic group, and leg arteries in group B (Table I). The latter observation accorded with an earlier report (4) that lower limb injuries accounted for most civilian admission for arterial trauma (4). The proportion of iatrogenic arterial injuries arising from various catheterization procedures ranges in the literature from 59% to 69%, whereas those complicating surgery were stated as 10% to 41% (3, 6, 10). Of our 22 cases of iatrogenic arterial injury, ten (45%) occurred during surgery. Table V summarizes 148 such cases collected from five reviews (5, 7, 9, 10, 12) and from the present study. Orthopaedic and general surgery were responsible for most iatrogenic injuries.

Haemorrhage, presenting either as an arterial bleed

Table III. *Clinical presentation of iatrogenic and noniatrogenic arterial injuries*

Clinical presentation	Iatrogenic injuries	Noniatrogenic injuries	<i>p</i>
Haemorrhage	3	17	<0.001*
Haemorrhage + ischaemia	1	11	
Ischaemia	14	10	NS
False aneurysm	4	4	NS
Arteriovenous fistula	0	1	NS
Total	22	43	

* Significant, NS = not significant.

Table IV. *Surgical management of iatrogenic and noniatrogenic arterial injuries*

Procedure	Iatrogenic injuries	Noniatrogenic injuries	<i>p</i>
Arterial ligation	2	4	NS
Thrombectomy	1	0	NS
Lateral suture	3	8	NS
Patch angioplasty	1	0	NS
End-to-end anastomosis	9	8	NS
Bypass	6	23	< 0.1
Autologous vein graft	1	22	
PTFE graft	4	1	
Dacron graft	1		
Total	22	43	

Table V. *Types of surgery resulting in iatrogenic arterial trauma (collected from 6 reviews)*

Series	Orthopaedic	General	Gynaecology	Urology	Cardiac	Vascular	Neurosurgery
Rich et al., 1974 (10) (<i>n</i> = 22)	2	2	4	4	4	2	4
Natali & Behnamou, 1979 (7) (<i>n</i> = 53)	35	14				4	
Pietri et al., 1981 (9) (<i>n</i> = 16)	3	9	2			2	
Boontje, 1981 (5) (<i>n</i> = 13)		7	2		2		
Youkey et al., 1983 (12) (<i>n</i> = 34)	3	1	8	11	7		4
Present series, 1990 (<i>n</i> = 10)	4	5					
Total	47	38	16	15	13	10	9
%	31.8	25.7	10.8	10.1	8.8	6.8	6.1

or as an expanding haematoma, occurred in 28 of our 43 noniatrogenic arterial injuries, but in only four of the 22 in the iatrogenic group ($p < 0.001$). The patients in that group presented mainly with severe or mild ischaemia. Close monitoring for signs of peripheral ischaemia thus is crucially important for early recognition of iatrogenic arterial injury in procedures

where such injury can occur. There was no significant intergroup difference in the incidence of arteriovenous fistula or false aneurysm. An apparent trend to perform bypass operations in the group with noniatrogenic arterial injury, although not reaching a statistically significant level, reflects the severity of the arterial injuries in this group. The high incidence of

associated venous, neural, skeletal and visceral injuries in group B (67% vs. 18% in group A) is another indicator of the severity of such injury. This significant difference ($p < 0.001$) was mainly responsible for the higher rate of permanent disability compared with the iatrogenic group ($p < 0.05$).

The postoperative mortality rate did not differ significantly between groups A and B, which accords with previously reported corresponding rates of 10% and 15% (3). Other authors found 4% (8) or 1.7% (12) mortality in their series of iatrogenic vascular injury, compared with 14% in our series.

The fairly low score for appropriateness of surgical technique shows that some of the iatrogenic arterial traumata in our series were potentially avoidable. Earlier authors (1) stated that one-fourth of iatrogenic complications, including arterial trauma, were due to faulty technique or failure to adhere to routines, whereas 10% were attributed to errors. Factors of two types have been implicated in iatrogenic vascular injury (2), viz. doctor-related (inadequate knowledge, inefficient anatomic dissection or traumatic or faulty technique) and patient-related (inflammation, tumour, irradiation, reoperation, anatomic variations). Substantial reduction of iatrogenic arterial injuries can be achieved from understanding all the established causal mechanisms (2). Most of them are related to arterial catheterization performed mainly by nonsurgeons. As iatrogenic arterial injuries may occur even in the most capable hands, they must be recognized and adequately corrected so as to reduce the risk of incapacitating sequelae.

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