Lumbar Sympathectomy in End Stage Arterial Occlusive Disease

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Sixty-one patients had lumbar sympathectomies performed for end stage occlusive vascular disease manifested by gangrene of less than one-half of the foot, ulcerating ischemic lesions, rest pain or rapidly progressive markedly limiting intermittent claudication. The operative procedure was standardized to permit removal of the lowermost preganglionic fiber at the level of the crus of the diaphragm and the ganglionated chain to the crossing of the iliac vessels. The immediate postoperative mortality was 6.5% from cardiac causes. Over all improvement rate was 60% while early amputation rate was 40% for the entire group. Those patients with rest pain had the poorest prognosis with an amputation rate of 53%.

The results are compared to other groups and factors of patient selection, anatomy of the sympathetic chain in relation to operative technique, physiology of decentralization versus denervation are discussed. The procedure is worthwhile in patients who are not candidates for arterial reconstruction who are faced with the prospect of early amputation.

SINCE ITS INTRODUCTION approximately 50 years ago by Adson and Brown,[1,5] lumbar sympathectomy has engendered considerable controversy. Originally introduced for the relief of vaso-spastic disorders, Smithwick and Atlas successfully employed it in the treatment of occlusive arterial disease as well.[2,12] As they apply to occlusive arterial disease, the controversies in part are due to differences in patient selection so that many series are not comparable to each other due to the widely different stages of occlusive disease included.[9,13] Indeed, some also report its effect on the patency rates of arterial reconstructions. In part, they may be due to differences in criteria for success. In some measure they may be due to differences in surgical technique.[9,14]

The present series is reported since it is made up of an easily defined population group of patients with end stage inoperable arterial disease of the lower extremities. These patients usually had either rest pain or ischemic lesions. Only a few had severely limiting rapidly progressing intermittent claudication. All patients had angiographic studies and their arterial occlusions were considered to be inoperable by criteria previously outlined[8] in that there was no portion of any tibial artery in communication with a pedal arch in the presence of either femoral, popliteal or tibial arterial occlusions. The surgical technique was standardized and was easily duplicated in successive cases.

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Materials

Sixty-one lumbar sympathectomies were performed by the authors on 58 patients from January, 1970 to December, 1974 for lower extremity arterial occlusive disease at the New York University Hospital. The follow up period was from 6 months to 4 and one half years. Four lumbar sympathectomies were performed in association with vascular reconstructions, of which 4 were excluded from this report.

Two categories of occlusive vascular disease were distinguished: atherosclerotic and aneurysmal. Representative examples of each are shown in Figs. 1 and 2. Forty-five limbs were atherosclerotic and 8 were aneurysmal in the series.

Patients had the usual ischemic symptoms characteristic of end stages of occlusive arterial disease with rest pain frequently associated with tissue loss predominating. A few had rapidly progressive intermittent claudication which had progressed to less than ½ block walking tolerance. If gangrene involved more than ½ of the foot, below knee amputations were performed without sympathectomy. All, including the few with

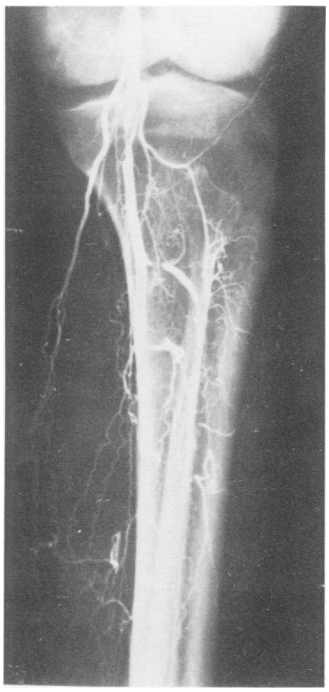

FIG. 1. Angiographic appearance of atherosclerotic occlusive disease. None of the distal tibial vessel is in continuity.

claudication, were thought to be candidates for early amputation.

A good result was manifested by one of the following: increased warmth of the skin associated with disappearance of rest pain, healing of tissue, however slow, and a generally nonpainful useful limb for at least 6 months after the operation. Improvement in exercise tolerance was also evaluated.

All patients who smoked were advised to stop and those with any walking tolerance were advised to walk one mile per day pushing themselves to the limits of pain tolerance. Antibiotics were liberally employed in the presence of open lesions.

A standard operative procedure was employed to achieve lumbar sympathectomy. The critical factor in the operative procedure was considered to be removal of the entire paravertebral lumbar sympathetic chain extending from the crus of the diaphragm to the crossing of the iliac vessels. The proximal transection was performed where the chain had a Y-configuration formed by the joining of the lowermost pre-ganglionic fiber to the ganglionated chain (Fig. 3) at the level of the crus of the diaphragm. A frozen section pathologic examination was routinely performed to confirm the presence of ganglion cells. The number of identifiable ganglia was quite variable.

Exposure for this extensive resection was achieved through a muscle splitting incision extending from the end of the 11th rib to the edge of the rectus sheath at the level of the umbilicus. The muscle layers were widely undermined along the direction of fibers. The kidney was mobilized anteriorly to permit access to the crus of the diaphragm.

Results

There were 4 deaths within one month of the operative procedure for a mortality rate of 6.5%. All deaths were from cardiac causes. There were 2 additional late deaths, one from a cerebral vascular accident, 6 months postop, and the other from carcinoma of the colon, one year postop. Of the 53 lumbar sympathectomies to be analyzed, 21 were performed for tissue loss, 19 for rest pain, and 5 for claudication of less than ⅓ of a block. The patients with claudication had rapidly worsened while under active treatment consisting of walking exercises. Although the series was almost equally divided between diabetic and non-diabetic patients, improvement was essentially the same for both groups, 62% for diabetics and 59% for non-diabetics (Table 1).

The improvement rate was greatest for those with claudication (100%). The improvement rate for those with tissue loss was 62% and for those with rest pain it was 47%. The severity of the occlusive process is illustrated

FIG. 2. Angiographic appearance of aneurysmal dilatation and distal occlusions.

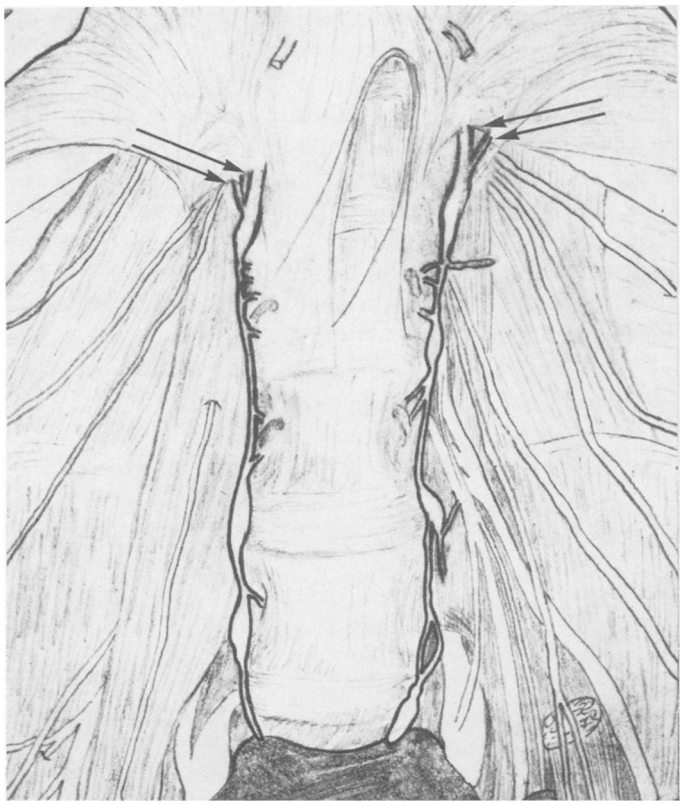

FIG. 3. Lumbar sympathetic chain; arrow showing uppermost lateral preganglionic fiber.

by the fact that those who did not show improvement underwent major amputations, for a rate of 38% for those with tissue loss and 53% for those with rest pain (Table 2). Amputations usually occurred within one to 2 months postop.

Patients with aneurysmal disease fared better. These were all considered to be inoperable on the basis of angiographic studies since all major tibial arteries were occluded. In this group there was one early amputation for a rate of 12% and one 2 years later for a total amputation rate of 25% (Table 3).

Discussion

The present series represents an easily defined group of patients with end stage arterial disease either due to atherosclerosis obliterans or thrombosed popliteal aneurysms with inoperable occlusion of tibial arteries.

TABLE 1. *Comparison of Results in Diabetic and Non-diabetic Patients*

	No. of limbs	Improved	Amp.
Diabetic	26	16	10
Non diabetic	27	16	11

TABLE 2. *Indication for Lumbar Sympathectomy and Results Tabulated by Degree of Limb Ischemia*

Symptom	# of limbs	Improved	Improvement Rate	Amp.	Amp. Rate
Claudication	5	5	100%	0	0
Tissue loss	29	18	62%	11	38%
Rest pain	19	9	47%	10	53%
Overall	53*	32	60%	21	40%

* Four patients with concomitent surgery and 4 postop deaths were excluded.

All patients were threatened with limb loss, and this is illustrated by the fact that those with tissue loss or with rest pain who did not improve following sympathectomy had an average early amputation rate of 40%. By inference then, 60% of this group might be considered to have avoided amputation due to a favorable response to sympathectomy. Indeed, many with intolerable pain expressed a desire to undergo amputation prior to improvement from sympathectomy.

It is conceivable that the variability of the lumbar sympathetic chain may be a factor to be considered in the end results reported by various groups. Ordinarily, lumbar sympathectomy is reported as the removal of a given number of sympathetic ganglia, usually 3 or more. The lumbar sympathetic chain, however, varies widely in its morphology.[10]

Recognizable swellings of the chain, identifiable as ganglia, may vary from one to 4. By microscopy, synaptic junctures can be seen along the entire length of the chain. Indeed, even the pre-ganglionic inflow may vary in level from D12 to L1 or L2. A standardization of surgical technique therefore would be desirable to permit comparisons of results. the criteria that we have employed have been easily taught and are recommended as a basis for comparisons.

Varying physiologic effects of removal of sympathetic structures were recognized as early as 1855 by Budge.[3] A concern of many subsequent investigators, the phenomenon was the subject of the final monograph written by Dr. Walter B. Cannon.[4]

In essence, pre or post-ganglionic sympathetic interruption results in increased sensitivity of the end organs deprived of circulating adrenaline. The hypersensitivity produced by post ganglionic interruption is

TABLE 3. *Comparisons of Results in Atherosclerotic and Aneurysmal Occlusive Limb Ischemia*

Disease	No. Limbs	Amputations		
		Early	Late	Total
AS	45	17	2	19 (42%)
AN	8	1	1	2 (25%)

tenfold while that produced by preganglionic interruption is only threefold.

Although the reaction of blood vessels is generally conceded to be identical to that of smooth muscle and glandular structures, some differences of opinion exist.[6,7]

The supersensitivity of denervated blood vessels is not limited to reactions to adrenaline but includes reactions to histamine, acetylcholine, pituitrin, ergotoxine, cooling and excitement. Indeed, pain, vigorous muscular activity, exposure to cold and hypoglycemia, which are associated with increased discharge of adrenaline from the adrenal medulla, also elicit the exaggerated response on the part of denervated blood vessels. Telford[14] and Smithwick[11] attempted to apply these facts to the technique of upper dorsal sympathectomy, suggesting that only preganglionic interruption be performed.

The technique of denervation herein described achieves both decentralization (preganglionic) and denervation (postganglionic) interruption and from the physiologic data would seem to be less desirable than decentralization alone. Although this may be critical in the treatment of vasospastic disorders in which immediate beneficial effects of sympathectomy may be followed months later by relapses, it is not clear whether this plays a role in failures of sympathectomy for occlusive disease. Supersensitivity becomes manifest within 8 to 16 days after denervation while failures of sympathectomy are usually evident within hours postoperatively by failure of increased skin temperature to develop. In addition, immediate good results tend to persist.[13]

The pathologic process which results in the arterial occlusions appears to play a role in the results of sympathectomy. Ischemia due to occlusive aneurysmal disease responds more favorably to sympathectomy than that due to atherosclerotic occlusions. The precise reason is not clear although it is apparent that the widespread marked thickening of the walls of the arteries associated with atherosclerosis is not as evident in arteriosclerotic aneurysms.

The question of whether pathologic involvement of the sympathetic chain is part of the pathologic process of generalized arterial disease has also been suggested but never thoroughly explored as a possible cause of the unpredictability and variability of results. Pick, who performed extensive electromicroscopic studies of excised sympathetic chains suspected that the changes in mitochondria which he observed signified that autosympathectomy had occurred in many of these patients.[10] This has been debated at the clinical level.

The effect of lumbar sympathectomy has been and still is unpredictable. Many techniques have been used preoperatively to anticipate the clinical response, the latest being the so-called Ankle-Brachial systolic pressure index.[15] This is an attempt to measure collateral circulation of extremities. It is not possible for us to comment on this technique.

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