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The use of topical vasodilators in microvascular surgery[☆]

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Summary Topical vasodilators are widely used in reconstructive microsurgery in order to ameliorate intraoperative vascular spasm (vasospasm) and facilitate microvascular anastomoses. There is, however, a paucity of literature to support or discredit this practice. A survey of current practice in UK Plastic Surgery Departments was therefore undertaken.

Email questionnaires were sent to all 281 consultant plastic surgeons in the UK and we received responses from 91 representing 35 out of the 49 'main' Plastic Surgery Units (71%). Of the 84 consultants who completed the questionnaire, the majority (94%) utilised vasodilators during microsurgery. The commonest preparations used were papaverine (52%), calcium channel blockers (47%) and local anaesthetics (27%). The most frequent reasons cited for topical vasodilator use were empirical (42%), habit (21%) and 'that it works' (16%). The agents were almost always applied topically (99%) compared to intraluminally in 19%. It is concluded that multiple vasodilators are employed routinely in UK microvascular surgical practice, but there is little scientific basis for their use.

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Introduction

When performing microsurgical anastomosis of blood vessels during trauma or free flap surgery, application of pharmacological vasodilators is common practice as it is believed to reduce vasospasm and dilate vessels. Although vascular spasm is common, occurring during 5–10% of such procedures, the causal mechanism is not completely understood.^{1,2} Addressing vasospasm adequately is important clinically as it not only makes suture placement difficult, but also causes a reduction in blood flow and an increased

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propensity for thrombus formation, both of which can result in tissue ischaemia and flap failure. Factors such as mechanical stretching of the vessel wall, endothelial damage, low ambient temperature, pH, anatomical location and haematoma formation are thought to contribute to this phenomenon.¹ However, the rationale for vasodilator use is poorly addressed in the plastic, vascular and transplant surgery literature. Hence, we decided to undertake a survey of vasodilator use amongst UK plastic surgeons. Between May and August 2008, an email questionnaire was sent to all 281 consultants in the 49 'main' Plastic Surgery Units listed in the BAPRAS Members & Associates 2008 Booklet.

Results

Ninety-one (32%) questionnaires were returned, representing 35 of the 49 UK Plastic Surgery Units (71%). All were completed by consultants, seven of whom no longer routinely perform microvascular surgery and thus had declined to complete it. Of the 84 completed questionnaires (Figure 1a), 79 (94%) consultants stated that they utilised vasodilators, with 45 (58%) always using them. The vasodilators are applied topically by 99% compared to almost a fifth (19%) who irrigate the lumen. Sixty-eight percent of respondents applied the vasodilator to both artery and vein, and 35% to artery alone (Figure 1b). Three respondents marked multiple options, which was interpreted as they selectively apply the vasodilator on a case-by-case basis.

Three-quarters of all consultants (60/79) indicated that they employ a single vasodilator, a fifth (17/79) mentioned two agents, while the final two respondents suggested three agents. Papaverine and verapamil are popular with 52% and 47% using these preparations respectively (Figure 1c). A quarter utilised lidocaine (24%) and marcaine, procaine and Glyceryl trinitrate were all mentioned by one respondent each.

The reason why particular preparations are used preferentially was answered by 67 consultants with the main cited responses being 'empiric' (42%), habit (21%) and that 'it works' (16%) (Figure 1d). The concentration and amount of topical vasodilator applied varied widely amongst the responses with a significant number not recording an answer or stating that they do not know.

Discussion

Our survey demonstrates that although there is widespread use of topical vasodilators (Table 1), there appears to be little scientific basis for this practice, the choice of agent, technique or frequency of application.

Whether surgeons applied topical vasodilators selectively to the artery, vein or both revealed interesting results. Studies of human vessels *in vitro* suggested that veins were more susceptible to vasospasm than arteries.² Clinically however, arteries tend to be more susceptible to spasm. It is, therefore, interesting that 68% of respondents applied their selected preparation to both artery and vein and 35% to the artery alone. Intraluminal compared to topical application of vasodilators has been the subject of much debate historically. Taking papaverine as an example, contradictory studies have shown that intraluminal, topical

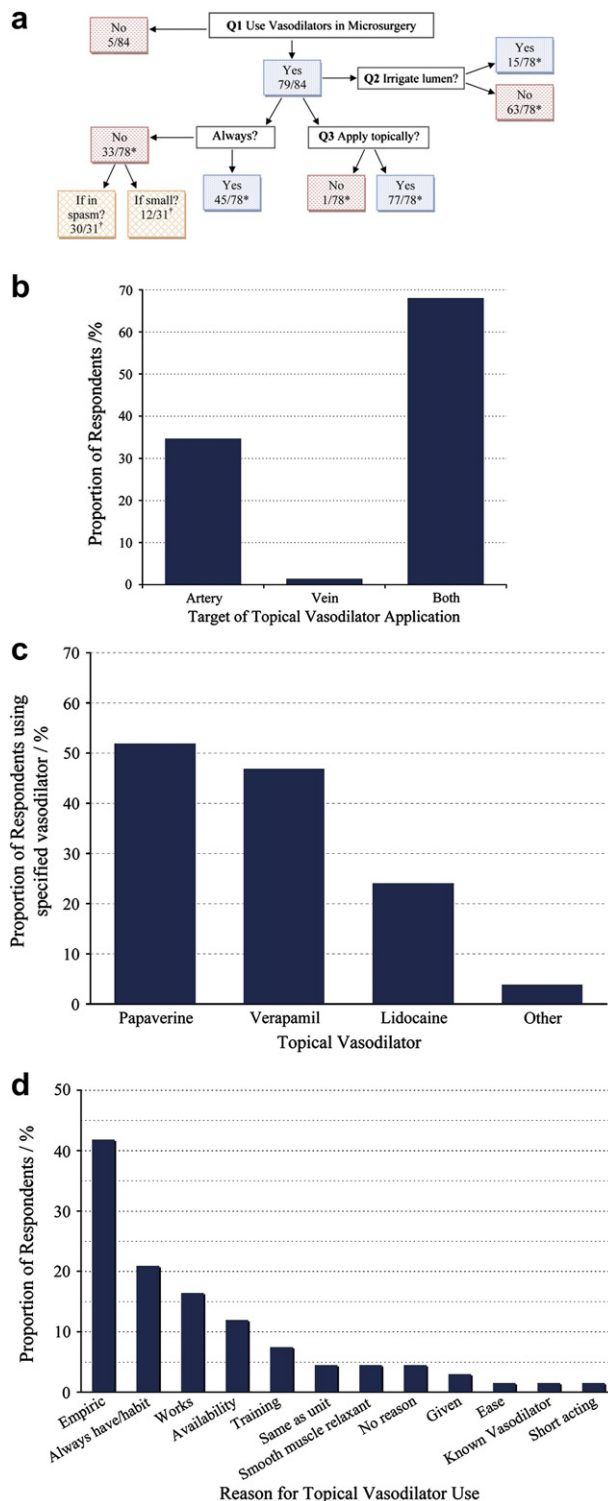


Figure 1 (a) Flow diagram showing the results from questions 1–3; *denotes that denominator has changed as one respondent did not complete this question; †denotes that denominator has changed as two respondents did not complete this question. (b) Vessel to which topical vasodilator is applied. (c) Responses stating topical vasodilator used. (d) Stated reason for topical vasodilator.

Table 1 Commonly used vasodilator agents in UK microvascular surgery

Agent	Structure	Mechanism of action	Concentration	Supplier
Papaverine hydrochloride	Benzylisoquinoline alkaloid	Phosphodiesterase inhibition	30 mg/ml	Martindale Pharmaceuticals, Essex, UK
Verapamil hydrochloride	Phenylalkyl-amine	Voltage-gated calcium channel antagonist	2.5 mg/ml	Abbott, Maidenhead, UK
Lidocaine	Amide	Voltage-gated sodium channel antagonist	10 mg/ml (1%)	Antigen Pharmaceutical, Surrey, UK

and even perivascular infiltration are individually optimal methods of administration.³

One of the commonest microvascular free flap procedures performed is breast reconstruction using the internal mammary vessels as recipients. Although plastic surgical literature on this topic is limited, the cardiothoracic data suggest that vasospasm of the internal mammary artery (IMA) during coronary artery bypass grafting is effectively prevented with intraluminal papaverine. However, other studies showed that flow increases after 15 minutes without any intervention.⁴ Whether, therefore, vasodilators are required at all is another question that needs to be addressed. However, one must be careful to draw conclusions from another speciality's data as the differing procedures result in variable dissection and handling of vessels, and thus different propensities to undergo vasospasm.

Although flow through anastomoses may improve after papaverine application, detrimental effects on endothelial cell viability and function have been suggested by *in vitro* studies.⁵ Our results show this preparation to be the most popular in UK Plastic Surgery Units (52% of respondents) and therefore assessing the appropriateness of this will have widespread implications.

In addition to pharmacological intervention, topical application of warm saline soaks to the vessels and their gentle mechanical dilation with vasodilating forceps should be mentioned for completeness. Although these techniques were not addressed in our study, they are widely used adjuncts in facilitating microvascular anastomoses.

This study has highlighted many questions that still need to be addressed. These include the need for comparative studies of different vasodilator preparations, concentrations, doses and routes of administration (for example,

intraluminal versus topical), all of which are important considerations when optimising efficacy and safety. These merit further study.

Conflicts of interest statement

None.

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