Carotid Endarterectomy: Technical Practices of Surgeons Participating in the GALA Trial

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Abstract
Objective: Recent meta-analyses confirm an advantage to patch angioplasty during carotid endarterectomy (CEA) and suggest a benefit from routine shunting. GALA Trial (RCT: general [GA] versus local [LA] anaesthesia for CEA) collaborators (non-UK [European] and UK) were surveyed to assess current practice techniques.

Materials and Methods: Postal questionnaires determined: shunt usage, monitoring techniques dictating shunt deployment, criteria for patching and the influence of anaesthetic technique upon these decisions.

Results: 157/216 surgeons (73%) replied. For UK surgeons (n = 76) performing GA CEA a shunt was always, never, or selectively used by 73.6%, 4.2% and 22.2% respectively. Figures for non-UK surgeons (n = 77) were 20.8% (p < 0.0001), 26% (p < 0.0002) and 53.2% (p < 0.0001). When shunting selectively, fewer UK surgeons relied on stump pressure (26.4% v 48.1%; p < 0.0064) with TCD more widely used (38.9% v 11.7%; p < 0.0001). Shunting criteria during LA CEA were the same for both groups (impaired awake-testing). Routine patching was commoner amongst UK surgeons (GA: 76.4% v 34.2%, p < 0.0001; LA: 70.1% v 31.9%, p < 0.0001).

Conclusions: These results indicate that more UK surgeons have adopted current suggestions for improving CEA outcomes. Future analysis of unblinded GALA Trial data may provide further information about the impact of different policies for shunting and patching.

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Introduction

Carotid endarterectomy (CEA) has a proven benefit in preventing future ipsilateral stroke in patients with a >50% symptomatic internal carotid artery (ICA) stenosis.1 Despite this there is considerable heterogeneity in the surgical techniques used to achieve this objective, and
the optimal methods for reducing short-term morbidity and mortality and long-term durability remain undetermined. Some of the issues that are unresolved include the indication for shunt utilisation, the choice technique for assessing the adequacy of intra-operative cerebral perfusion, use of a patch for arteriotomy closure and the type of patch material that minimises early ICA occlusion and long-term re-stenosis.

Finally it has been suggested that the method of anaesthesia might influence outcome. Whilst local anaesthesia was preferred by many early carotid surgeons a shift to general anaesthesia (GA) followed the report by Wells et al. which suggested GA may promote cerebral protection. These views have been challenged by studies that suggest preservation of cerebral auto-regulation and sympathetic drive during local anaesthesia (LA) and these controversies were discussed in a review by McCleary et al. Further, although data from non-randomised, studies suggest a benefit to LA CEA (reduction in stroke, MI and death rates) there is insufficient evidence currently to dictate a change in practice regarding the type of anaesthesia. Analysis of the data from the GALA Trial may resolve this issue.

At the time of survey trial collaborators comprised 216 surgeons in 71 centres and this cohort has provided a unique opportunity to identify the technical practises currently employed by surgeons throughout Europe.

These aspects of CEA in the UK have been assessed previously by Murie et al. in 1989, 1991 and 1994. These serve as basis for comparison with current data.

This study reports the results from a questionnaire based on a survey of the surgeons participating in the GALA trial. Furthermore technical practises regarding CEA in the UK and Europe have also been compared with the practises followed by the participants in the European Carotid Surgery Trial (ECST).

Method

Postal questionnaires determined: shunt usage, monitoring techniques dictating shunt deployment, patch use, patching criteria, and the influence of anaesthetic technique (GA/LA) upon these decisions amongst surgeons participating in the GALA trial. The Trial protocol stated that a shunt should only be used during local anaesthetic surgery when indicated by awake testing. For all other technical aspects of surgery Trial participants were advised to continue their normal practice. The results were analysed using SPSS statistical software.

Results

Questionnaires were sent to 216 surgeons in 71 centres in Europe (non-UK) and UK. 157 questionnaires (73%) were returned from 68 (96%) centres (Europe – 77; UK – 76).

Shunt utilisation

On cumulative analysis 47% of the surgeons always use a shunt when performing a GA CEA as compared to 1% under LA. Only 50% of the surgeons used a shunt selectively during GA CEA as compared to LA surgery (37% vs. 73%). The practise of the surgeons who rarely or never use a shunt (GA: 15%; LA: 16%) was not influenced by the type of anaesthetic.

Comparative analysis of shunt utilisation under GA (Fig. 1) showed that 73.6% of UK surgeons always used a shunt as compared to 20.8% in rest of Europe (p < 0.0001). Selective shunting with intraoperative monitoring of a marker of cerebral perfusion was less common in the UK (22.2%) as compared to Non-UK European surgeons (53.2%; p < 0.0001). 4.2% of the UK surgeons never used a shunt under GA compared to 26% in Non-UK Europe (p < 0.0002).

Intra-operative monitoring

There was a wide diversity in the methods used for monitoring intra-operative cerebral perfusion when a policy of selective shunting was used during GA surgery. Carotid stump pressure measurements were used most often (37%), followed by transcranial doppler (TCD, 25%). Electroencephalography (EEG) was used by 10% of the surgeons and somatosensory evoked potential (SSEP) and near-infrared spectroscopy by 5% each. Of the remaining 27 surgeons (18%) 25 did not use any form of monitoring during GA CEA (3 UK, 22 non-UK) and 2 non-UK surgeons used another unspecified monitoring technique. Of the 25 surgeons who performed no monitoring 13 never or rarely used a shunt during GA surgery whilst the remainder did so in the presence of contra lateral disease or poor back flow from the ICA.

There were significant variations in this practice between the UK and Non-UK European surgeons (Fig. 2), with TCD being the most common modality employed in the UK (38.9%) as compared to stump pressure in the rest of Europe (48.1%). EEG and SSEP were also more commonly used in Europe (32.5% v 4.2%; p < 0.0001).

Patch angioplasty

Routine patch angioplasty was significantly more common in the UK (76%) compared to the rest of Europe (34%; p < 0.0001). Further 52.6% of the Non-UK surgeons practise...
selective patching compared to 19.4% of UK surgeons (Fig. 1). A small artery was the most common reason for selective patching although only 8% of the surgeons used objective arterial diameter measurement prior to decide this. Other reasons for selective patching included: female sex, re-stenosis after previous CEA (ipsilateral or contralateral), shunt use and a tortuous ICA. Finally 13.2% of the Non-UK European surgeons and 4.2% of the UK surgeons never use a patch irrespective of the ICA size or the type of anaesthetic used.

Dacron was the most commonly used patch material by all surgeons (UK 82%; Non-UK European 60%), followed by Polytetrafluoroethylene (PTFE) and vein. Both PTFE and vein patch were used more commonly in Non-UK Europe (Fig. 3).

Discussion

The results have been compared to those from a previous UK surveys by Murie et al. in 1986, 1991 and 1994.6-8 In the previous UK survey (1994) obligatory shunting (35%) and patching (21%) were less frequent (p < 0.003; stump pressure p < 0.006; EEG/SSEP p < 0.0001).

A slight alteration in the survey questions makes direct comparison of these studies difficult but overall there was an increased utilisation of patches to cover the arteriotomy site, with vein patches being the most popular. Similarly a significant increase in routine and selective utilisation of intra-operative shunts was seen, particularly compared to the 1989 survey.7 Stump pressure measurement was the most commonly used parameter to dictate shunt deployment in these studies with virtually all CEAs being done under GA, particularly in the first two surveys.

Although there is strong evidence to support the routine patch angioplasty9 during CEA there is insufficient evidence from previous meta-analyses of randomised control trials to give clear guidance in respect of the type of patch or the routine use of a shunt.10 The data presented in this study reflects current variation in technical practice in Non-UK Europe and UK. Further, it allows comparison with the data from ECST11 to identify changes in practice.

Although not the focus of the current study it is interesting to note that only one UK surgeon was using LA in the 1986 UK survey6 and 2–5 surgeons in subsequent surveys in 1991 and 1994.6,8 Similarly only 3.4% of operations were preformed under LA in the ECST trial.11 The widespread use of GA is reflected by the controversy over the use of a shunt and the selection of the most appropriate modality for identifying patients who will benefit from this when a strategy of selective shunting is adopted. Thus, there is a considerable variation in shunt utilisation during CEA with some surgeons shunting all patients and others never using a shunt because of the potential risk of neurological complications through platelet and air emboli, intimal damage, late re-stenosis and arterial dissection. Compared to previous data there has been a significant increase (p < 0.0001) in obligatory shunting by UK surgeons from 33% and 38% in previous surveys,6,7 and 45% in ECST11 to 73% in the current study. Conversely routine shunting by Non-UK European surgeons has remained low at 30% in ECST and 20% in GALA. Not surprisingly, selective shunting is more prevalent amongst Non-UK Europeans (53%) compared to UK surgeons (22.2%) whilst only 4.2% of the latter never use a shunt compared to 26% of the former when performing GA CEA.

In a review by Bond et al.12 in 2002 the authors concluded that there was insufficient evidence to support either routine or selective shunting during CEA although available data suggested that a combination of EEG monitoring and carotid pressure assessment may reduce the number of shunts used under GA. This difficulty in identifying a reliable method of selecting patients for shunting is a major attraction to performing LA CEA with shunt deployment decided upon the results of awake testing.

Although the concept of selective shunting is logical, the inadequacy (false positive and false negative results) of current techniques to identify appropriate patients, and the differential impact of anaesthetic type upon cerebral autoregulation make this difficult. Thus both EEG and carotid stump pressures may be normal in 6-30% of patients who subsequently develop neurological signs and abnormal in 3-11% of those who do not develop signs of ischaemia.13,14

Traditionally stump pressure measurement was the most common monitoring method used for selective shunting in the UK. In the present survey this remains the case for all
surgeons participating in the GALA trial (37%) followed by TCD at 25%. However TCD was the most common mode of intra-operative monitoring used for selective shunting by UK surgeons (38.9%) compared to stump pressure in Non-UK European surgeons (48.1%). EEG has become less popular amongst UK surgeons with 23% using this in the ECST trial but only 4.2% in the GALA trial.

The benefits of patching continue to be debated. Although conclusive evidence could not be drawn in the 2004 Cochrane review,\(^{10}\) the report appeared to recommend routine patching to reduce early ICA occlusion and late re-stenosis. Thus patching was also associated with a reduction in the risk of stroke or death rates \((OR \ 0.59, \ 95\% \ CI \ 0.42 \ to \ 0.84, \ p = 0.004)\), equivalent to about 75 fewer deaths or strokes per 1000 patients who received a patch. Although the review was considered inconclusive due to methodological flaws in the original trials patch utilisation in the UK has undoubtedly increased over the last 2 decades (Fig. 3). Thus, in 1986 only 2% of UK surgeons always used a patch compared to 21% in the ECST trial\(^{10}\) and 27% in the Murie’s 1994 survey.\(^{7}\) Although patch use was more prevalent amongst Non-UK European surgeons (32%) in ECST data from the current study shows that there has been no real change since then (34%) whilst 76% of UK collaborators now patch routinely.

Bond\ et al. also reviewed 8 trials (1480 operations) to estimate the impact of patch-type on early and late outcomes after CEA.\(^{15}\) Although the synthetic patches were associated with reduced morbidity and operative time associated with a vein harvest, there was no conclusive evidence to support a particular type of patch in improving outcomes. In a later study by Verhoeven \ et al.\(^ {16}\) who reviewed 319 patients undergoing CEA (26% primary closures, 53.6% vein patches and 20.4% Dacron patches), re-stenosis rate was more common after Dacron patching or primary closure. That these differences were more profound in the females was explained on the basis of their smaller calibre vessels.

Although vein patches harvested from the ankle were initially popular in the UK reports of postoperative patch rupture and increasing use of LA CEA has lead to the predominant use of synthetic patches. Previous reports suggest that PTFE was more widely used previously but data from the GALA trial shows that Dacron is now the most commonly utilised material in both Europe and UK although a proportion of Non-UK European surgeons are more likely to use a vein or a PTFE patch (Fig. 1).

In conclusion this report highlights a wide variation in the use of patches and shunts across Europe. This could be a potential source of heterogeneity in the data from the GALA trial and multivariate analysis of the impact of perioperative processes of care will be necessary in the final analysis of the trial results. Nevertheless, these variables did not influence the results of ECST trial and unless data to the contrary is provided by GALA trial, surgeons should continue their ‘usual’ surgical practice.

### Ethical approval

N/A.

### Funding

Funded.

### Conflict of interest

No.

### List of centres participating in this survey

**UK**

1. Leeds General Infirmary
2. Royal United Hospital Bath NHS Trust
3. Southampton General Hospital
4. Royal Lancaster Infirmary
5. North Bristol NHS Trust, Southmead Hospital
6. Bristol Royal Infirmary
7. St Mary's Hospital
8. The John Radcliffe Hospital
9. Belfast City Hospital
10. Royal Glemorgan General Hospital
11. Northern General Hospital
12. The Freeman Hospital
13. Guy’s & St Thomas’ Hospital
14. Pindersfield General Hospital
15. St James’s University Hospital
16. Royal Bournemouth Hospital
17. Royal Free Hospital
18. Hereford County Hospital
19. Stirling Royal Infirmary
20. Worcestershire Royal Hospital
21. Countess of Chester Hospital
22. The Royal Oldham Hospital
23. Huddersfield Royal Infirmary
24. Addenbrooke’s Hospital
25. Blackburn Royal Infirmary
26. Hull Royal Infirmary
27. St George’s Hospital
28. Aberdeen Royal Infirmary
29. Arrowe Park Hospital
30. Norfolk and Norwich University Hospital
31. Royal Bolton Hospital
32. Hillingdon Hospital
33. Watford General Hospital
34. The Ayr Hospital

**Non-UK**

1. Georgian Centre of Angiology and Vascular Surgery (Georgia)
2. San Salvatore Hospital (Italy)
3. Mauriziano Hospital (Italy)
4. Hospital S João (Portugal)
5. Institute for Clinical and Experimental Medicine (Czech Republic)
6. Sodersjukhuset (Sweden)
7. University Hospital Merkur (Croatia)
8. Instituto Ortopedico Galeazzi (Italy)
9. Ibn-1 sina Hospital (Turkey)\(^ {1}\)

\(^ {1}\) Centres included as Non-UK centres for the purpose of this survey.
Carotid endarterectomy: technical practices

References


