Three wound-dressing strategies to reduce surgical site infection after abdominal surgery: the Bluebelle feasibility study and pilot RCT

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Scientific summary

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Background

Each year 4.5 million operations are performed in England. Surgical site infections (SSIs) complicate up to 25% of procedures. Many SSIs resolve with simple treatment but many cause morbidity and major costs for the NHS. Every effort, therefore, is made to minimise risks of developing SSI. One area of controversy is the role of wound dressings. A wide variety of dressings are available and sometimes dressings are not used at all, with primary wounds left exposed to heal. Evidence about the effects of wound dressings/no dressing for the prevention of SSI in primary surgical wound healing is limited. Another area of controversy is the definition of SSI. Existing definitions lack good agreement and satisfactory psychometric properties. A validated, patient-completed measure of SSI is also needed for SSI surveillance after discharge.

Objectives

The overall aim of the Bluebelle feasibility study was to establish whether or not it is possible to carry out a major randomised controlled trial (RCT) to compare the clinical effectiveness and cost-effectiveness of different dressing strategies or no dressing to reduce SSI following elective surgery and to develop a valid method for the assessment of SSI to be used in the main trial.

Design

Phase A included case studies with in-depth interviews with health-care professionals (HCPs), including surgeons and nurses, and participants and the development of outcome measures to assess SSI, patient experience of wounds and practical wound management. Based on this work, it was decided to expand Phase A to also include surveys of current dressing practice, working with members of the Severn and Peninsula Audit and Research Collaborative for Surgeons (SPARCS) and the West Midlands Research Collaborative (WMRC); an updated literature review to summarise the evidence of tissue adhesive as a dressing, working with the Cochrane wounds group; and a value-of-information (VoI) analysis, working with the Medical Research Council (MRC) ConDuCT-II Hub in Bristol.

Phase B was a pilot RCT with integrated qualitative research and an integrated questionnaire validation study.

Patient and public involvement was included in both phases.

Setting

Phase A: qualitative case studies in general surgical departments and an obstetric department, as in Phase B, and surveys in 25 general surgical departments in West Midlands and South West hospitals in the UK.
Phase B: general surgical NHS departments in Birmingham, Worcester and Bristol, and one obstetric NHS department in Bristol NHS.

Participants

Patients undergoing elective and unplanned (emergency) abdominal operations, including caesarean section, with a primary closed surgical wound, and doctors and nurses caring for patients having these operations, were eligible.

Interventions

Phase A was preliminary work to inform a pilot RCT and, therefore, there were no interventions. In Phase B participants were randomised (1 : 1 : 1) to any sort of simple dressing, to tissue adhesive (glue) as-a-dressing or to 'no dressing' where the wound was left exposed.

Main outcome measures

The outcomes of interest for Phase A were establishing an understanding of current views and opinions of wound dressings and their role in SSI development; developing of questionnaires to assess SSI, patient experience and wound management; establishing the prevalence of current dressing practices; and analysing the VoI of a main trial. Findings from Phase A activities were used to inform the design of a pilot RCT (Phase B).

The outcomes of interest in the pilot RCT in Phase B were participants screened, proportions consented and randomised; acceptability of and adherence to interventions; questionnaire response rates; validity and reliability of SSI measure; main cost drivers; and the design of a main RCT.

Methods

Phase A included case studies with in-depth interviews to understand views of current dressing practice, surveys of current dressing practice, questionnaire development using mixed methods and VoI analyses. A literature review was undertaken in collaboration with the Cochrane wounds group. Six databases were searched, without restrictions on language, date of publication or study setting, for RCTs with wound exposure (no dressing) or alternative wound dressings for the postoperative management of surgical wounds healing by primary intention. Two review authors extracted the data independently. Phase B was a pilot factorial RCT, randomising by dressing type (simple dressing vs. glue-as-a-dressing vs. no dressing) and timing of disclosure of dressing allocation (before vs. after wound closure), with integrated qualitative research and a study to validate the new measure of SSI. We investigated different times of disclosure of dressing allocation to try to find out whether or not the dressing allocation affected the quality of wound closure.

Results

Phase A

Case studies

Interviews were undertaken with 102 participants (69 HCPs and 33 eligible patients). HCPs had variable interpretations of the term 'dressing' and reported using whatever product was available on the wards. They were unfamiliar with the terms 'complex' and 'simple' when applied to dressings, as described in the commissioning brief. Participants suggested a range of practical/clinical reasons for using dressings. These included the role of dressings to prevent external contamination and to minimise exudate leakage onto clothing and bedding. Concerns about dressings potentially harbouring infection or delaying its diagnosis were also expressed. Interviewees generally acknowledged uncertainty about the association between dressing use and SSI. They felt that a RCT including a 'no dressing' group was acceptable.

Survey of current practice

Twenty-five hospitals within the SPARCS and WMRC networks were approached and 20 participated. Data from 727 patients (1794 wounds) were included, of whom 193 (26.5%) underwent upper gastrointestinal surgery. The number of wounds per patient varied from one to seven [the majority had one wound; $n = 299$ (41.1%)]. Complete data sets were submitted for 675 patients (92.8%). Sutures were most commonly used to achieve skin closure ($n = 1531$, 86.5%). Most dressings in use were classified as simple

(1203 of 1769, 68.0%), with just 1.0% (18 of 1769) classified as advanced. Tissue adhesive was applied over closed skin to 27% of wounds (485 of 1769). Dressing types were similar across different types of procedure and between elective and unscheduled surgery. There was no apparent association between the type of dressing used and patient risk factors, such as diabetes mellitus, stoma formation, body mass index or American Society of Anesthesiologists fitness grade.

Development of a SSI questionnaire for patient self-report

A list of 42 items generated from the literature and existing measures of SSI were grouped into 18 domains, eight measuring SSI signs and symptoms and 10 measuring wound management interventions. Interviews (participants, $n = 37$; HCPs, $n = 24$) confirmed these categories and identified an additional domain of 'smell', creating a total of 19 domains for inclusion in the new measure. Cognitive interviews iterated items in the new measure, the Wound Healing Questionnaire (WHQ), to optimise understanding and face validity, and finally resulted in a 16-item questionnaire for psychometric testing.

Development of patient experience and practical wound management questionnaires

Analyses of existing RCT outcomes and interviews produced a total of 69 issues related to practical issues and patient experiences of primary surgical wounds and dressings. Pre-testing and iterative revision established the need for two separate measures. One measure, the Wound Management Questionnaire (WMQ), addresses HCPs' experience of wound management in two key areas: (1) exudate and its impact and (2) allergic reactions to the dressing. The other measure, the Wound Experience Questionnaire (WEQ), addresses patients' experience of wounds in seven key areas: (1) wound comfort, (2) dressing removal, (3) dressings to protect the wound, (4) impact on daily activities, (5) ease of movement, (6) anxiety about the wound and (7) satisfaction with dressing. Each measure took < 5 minutes to complete and was easily understood by and acceptable to patients and HCPs.

Value-of-information analyses

We found that the existing evidence base for the relative effectiveness of different wound-dressing types was limited in quality and lacked precision. A cost-effectiveness analysis based on this rather limited evidence base suggests a high level of uncertainty as regards the most cost-effective dressing type. Our VoI analyses indicate that there is substantial benefit in a trial to compare dressing types. After inclusion of the results from the Bluebelle Phase B study, we estimated the population expected value of sample information (EVSI) of a trial of simple dressing compared with tissue adhesive as-a-dressing and with no dressing, with 3000 participants randomised, to be £1556M. Population EVSI was much larger than the cost of such a trial for the range of sample sizes we explored, suggesting that a trial is likely to represent an efficient use of resources.

Phase B

Pilot RCT

Between 4 March 2016 and 30 November 2016, we approached 862 patients for the pilot RCT; 699 (81%) were eligible, 415 (59%) consented and 394 (56%) were randomised (simple, $n = 133$; glue, $n = 129$; no dressing, $n = 132$; non-adherence was 3/133, 8/129 and 20/132, respectively). Recruitment accelerated, with the total number of participants randomised exceeding the target. Six randomised participants were excluded, giving an analysis population of 388, 311 of whom (80%) had abdominal surgery. Adherence to dressing allocation was > 97% for the initial dressing and > 86% for participants requiring one or more wounds to be redressed. Adherence to timing of dressing allocation disclosure was 99% and 86% before and after wound closure, respectively. Most wounds were closed with sutures and most participants were prescribed prophylactic antibiotics, similarly in all three groups. The WMQ and WEQ at 4 days were completed by > 90% (355/385) of participants. At 4–8 weeks, participants' response rates were 67% (254/378) for the WHQ and 64% (242/377) for the EuroQol-5 Dimensions, five-level version (EQ-5D-5L). The WHQ was completed by a HCP for 74% participants (281/378). Completion rates were similar in the three groups. The face-to-face reference SSI assessment was carried out for 80% (303/377) of participants, most often for those allocated to no dressing (107/128, 84%) and least often for those allocated to simple dressings (97/127, 76%).

The reference assessment was unblinded for 58 out of 302 (19%) participants; unblinding occurred most often in the glue-as-a-dressing group (31/100, 31%) and least often in the simple dressing group (11/96, 11.5%). SSI occurred in 51 out of 281 cases; 45 out of 49 cases were classified as superficial, three as deep and one as organ space (two were not classified). There were 21 serious AEs in eight participants and 138 non-serious AEs in 73 participants that were related to participants' wounds.

Integrated qualitative research

We interviewed 55 participants. All dressing strategies were acceptable to stakeholders and there were no major adherence or acceptability issues. Participants who had experienced using the transfers were positive about their application and utility; those who had not encountered them envisaged their role positively. Notably, patients' understanding and awareness of the Bluebelle study and their allocated dressing strategy appeared to be key in promoting adherence. Bluebelle study processes did not appear to have an impact on HCPs' usual practice; wound management for participants with 'no dressing' and 'glue-as-a dressing' was not perceived to differ from that for participants who had simple dressings. Research nurses indicated that the success of a main trial would depend on staff engagement and co-ordination; they felt that the model adopted for the pilot RCT, with research nurses leading most components of the trial, would need better support in a main RCT.

Validation of the WHQ

The WHQ had good psychometric attributes. When it was completed, few data were missing; responses were distributed as expected; agreement between participant and observer, and within participants, was good (test–retest and Cronbach's alpha of > 0.7). All items in the WHQ fitted a single scale that made clinical and practical sense; Cronbach's alpha coefficients for a single scale were between 0.8 and 0.9, whether patient-completed or observer-completed. The WHQ demonstrated good sensitivity and specificity compared with the reference SSI assessment (c-statistic = 0.906).

Health economics

It was feasible to obtain detailed information on the types of dressings used, the frequency of dressing changes and the health-care resources used to treat wound-related problems (data completeness ranged from 80% to 98% for all categories of resource use). Key cost drivers were hospital appointments, dressings and redressings, use of new medicines and primary care appointments.

Limitations

Multiple activities required for the study, often carried out in parallel, were challenging to co-ordinate. A main trial would require formal processes to co-ordinate the efforts of different teams and track the large numbers of people involved.

An amendment to the pilot RCT took 4 months. Without the delay, the pilot RCT could have recruited more quickly, particularly those patients having unplanned operations.

Only 80% of pilot RCT participants had a reference SSI assessment. We cannot rule out attrition bias, but note that attrition was similar across groups.

Participants' response rates at 4–8 weeks were 67% for the WHQ and 64% for the EQ-5D-5L. We believe that the WHQ response rate could be improved in a main trial, because only the WHQ would be collected at 4–8 weeks.

We could not routinely capture digital photographs in theatre after wound closure, preventing an assessment of performance bias as a result of knowledge of the dressing allocation before wound closure. During the last month of recruitment, we implemented a method allowing participants to submit photographs of their wounds securely, which was used by only one-third of participants.

Conclusions

A main trial of different dressing strategies, including no dressing, is feasible and would be valuable to the NHS. Patients and HCPs supported the premise of a future trial and accepted that there is equipoise in this area. We developed, validated and tested a new tool for assessing SSI, namely the WHQ, that can be used by patients after hospital discharge.

Future work

We describe a main trial with three or two groups (i.e. without the 'no dressing group). We prefer a three-group trial because of the potential interaction between allocated dressing strategy and quality of wound closure. The NHS needs to decide whether the research question should be about the effect of different dressing strategies or about the combined effect of different dressing strategies and any effect on how surgeons close wounds. We recommend a primary outcome combining evidence of SSI at discharge and the patient-reported WHQ at 4–8 weeks, with researchers required to demonstrate a response rate of > 90% in an internal pilot.

We recommend further research to:

- facilitate patient wound photography, primarily to determine if SSI can be ascertained from a photograph and to allow a blinded assessment to be made
- facilitate collection of digital wound images in theatre; this would create research opportunities that extend beyond wound-related research (e.g. defining interventions and monitoring intervention fidelity)
- develop a metric of the quality of wound closure; we characterised wound appearance but further research is needed to develop and validate a metric, which is required to test whether or not there is an interaction between dressing type and quality of wound closure
- validate the WMQ and WEQ to make them valuable tools for use in future trials.

Trial registration

This trial is registered as (Phase A) ISRCTN06792113 and (Phase B) ISRCTN49328913.

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