Incidence of injection-site lesions in beef top sirloin butts

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J Anim Sci 2001. 79:2615-2618.

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ABSTRACT: Damaged beef muscle tissue resulting from intramuscular injections of animal-health products represents a "quality control" problem and an economic loss to the beef industry. Fifteen individual and sequential national audits of injection-site lesions in beef top sirloin butts have been conducted at the steak provisioner/cutting level between November 1995 and July 2000. The national incidence of injection-site lesions in top sirloin butts (n = 240,080) decreased ($P < 0.05$) between November 1995 (11.4%) and July 2000 (2.1%). From November 1995 to July 1997, mean weight per injection-site lesion, across all lesion classes, increased ($P < 0.05$) from 192.5 g to 435.8 g, respectively; mean weight per lesion subsequently decreased ($P < 0.05$) to 249.8 g in July 2000 but was still heavier ($P < 0.05$) than in November 1995. Results of these audits suggest that producers have changed injection practices. These changes have likely been in response to educational efforts, such as those made by National Cattlemen's Beef Association and through state beef quality assurance programs. Analyses of results for lesion classes, partitioning lesions according to chronological stages of the healing process, suggested that the majority of lesions were induced at times that coincide with cow-calf, stocker, or early finishing-period stages of cattle production.

Key Words: Beef, Damage, Injection, Lesions, Tissues

 J. Anim. Sci. 2001. 79:2615–2618

Introduction

Results of the National Beef Quality Audit—1995 (Smith et al., 1995) revealed that 30 to 40% of purveyors, retailers, and packers believed that the frequency of injection-site lesions had decreased since a similar audit in 1991. Even with such improvement, purveyors and retailers still ranked this defect among the top-10 challenges of fed steers and heifers. Pharmaceuticals are commonly administered to cattle at various stages of their lives (Taylor and Field, 1999). If injections are given intramuscularly, in the anatomical region between the hooks and pins, tissue damage occurs (Dexter et al., 1992). Injection-site lesions are seldom detected at packing plants because damage is concealed within the muscles and subcutaneous fat. Unless top sirloin butts are further processed by packers (including removal of subcutaneous fat and separation of the biceps femoris from the gluteus medius), injection-site damage will normally be exposed at retailer or purveyor establishments during portioning of the primal cuts.

Dexter et al. (1994) reported that activities of the National Cattlemen's Association (subsequently, the National Cattlemen's Beef Association, **NCBA**) Quality Assurance Advisory Board led to a reduction in the incidence of injection-site lesions from 21.3% (July 1991) to 10.9% (March 1993). George et al. (1996) reported that a continuation of these efforts did not result in a reduction in injection-site lesion incidence from July 1993 (10.9%) to July 1995 (10.2%). Since July 1995, 15 audits have been conducted to determine the impact of beef quality assurance efforts of cattlemen's organizations on the incidence of injection-site lesions in the top sirloin butts of fed steers and heifers. This paper is a sequel to those by Dexter et al. (1994) and George et al. (1996) and reports the results of national audits of injection-site lesion incidence in top sirloin butts from fed steers and heifers using data collected from November 1995 through July 2000.

Materials and Methods

General Protocol. To obtain ongoing assessments of the incidence and severity of injection-site lesions in top sirloin butts on a national scale, data were collected from individual steak-cutting plants located nationwide. Audits in each of four plants were conducted in November 1995; in each of March, July, and November

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Received January 8, 2001.

Accepted May 8, 2001.

of 1996, 1997, 1998, and 1999; and in March and July of 2000. Facilities audited were selected according to 1) U.S. geographic location and 2) quantities of top sirloin butts processed at that location. To ensure that adequate quantities of top sirloin butts were evaluated, two shifts (8 to 9 h) were audited at each plant visited during each audit period. Audit procedures were identical to those described by Dexter et al. (1994).

At each of the audited facilities, all steak cutters were provided verbal instructions concerning the audit process and were shown how the affected tissue (injection-site lesion) looked in top sirloin butts/steaks. Steak cutters were asked to hold product with affected tissue for evaluation by the investigator. As each individual top sirloin butt was portioned into individual steaks, the exposed injection-site damage was excised from all affected steaks. The excised damaged tissue was subsequently classified using a 5-point classification system as described by Dexter et al. (1994) and weighed (to the nearest gram).

Statistical Analysis. Data representing the percentage incidence of injection-site lesions were analyzed using the frequency procedure of SAS (SAS Inst. Inc., Cary, NC). Differences between incidence values associated with the 15 audit time periods were determined by calculating the chi-square statistic. Means for lesion weight were computed and analysis of variance was conducted using the GLM procedures of SAS (SAS Inst. Inc.). Least significant differences were used to identify statistical differences among mean lesion weights when analysis of variance demonstrated an effect of the audit period and(or) lesion type ($\alpha = 0.05$).

Results and Discussion

The average incidence of injection-site lesions during the audit period of November 1995 was 11.40%, which was numerically higher than the 10.19% incidence reported by George et al. (1996) for the audit period of July 1995. The average weight of injection-site lesions excised from affected top sirloin butts during the November 1995 audit was 192.5 g, which also was numerically heavier than the 152.8 g lesion weight found in July 1995 (George et al., 1995).

Over the entire 15 audit periods included in this report, the incidence of injection-site lesions decreased (Table 1) from a high of 11.40% in the first audit period (November 1995) to a low of 2.06% in the last audit period (July 2000). The decline in numerical injection-site lesion incidence was continuous, with each subsequent incidence lower ($P < 0.05$) than the preceding audit incidence, over the 15 audit periods, with the exception of the following: a) the July 1996 to November 1996 audit periods, the July 1997 to November 1997 audit periods, the November 1998 to March 1999 audit periods, and the November 1999 to March 2000 audit periods, in which the incidence did not change, and b) the March 1998 to July 1998 to November 1998 audit periods, in which the incidence of injection-site lesions peaked ($P < 0.05$) in July 1998 and then returned to previous levels in November 1998. The incidence of injection-site lesions in fed steer and heifer top sirloin butts was lower than incidences reported by Van Donkersgoed et al. (1997, 1998); in those two studies, the incidences of lesions in Canadian fed beef top sirloin butts were 18.8% and 13.3% in the fall of 1996 and in the spring of 1997, respectively. A reduced incidence of injection-site lesions from November 1995 to July 2000 corresponds to the downward trend reported by Dexter et al. (1994); in that study, lesion incidence declined over the six audit periods between July 1991 to March 1993. During the period covered by the report of George et al. (1996), no decrease in injection-site lesion incidence occurred over seven audit periods from July 1993 to July 1995. Across the entirety of the period covered by successive reports of Dexter et al. (1994), then George et al. (1996) and now this study, the decrease in injection-site lesion incidence has decreased by 19.2 percentage points, suggesting that producers have changed injection practices. These changes have likely been in response to educational efforts, such as the National Cattlemen's Beef Association's and state beef quality assurance programs. Even with such a decline of the incidence in top sirloin butts in past years, the beef industry must remain cautious and the education must continue to develop as the incidence of injection-site lesions in fed steer and heifer rounds was 11.3% in the 2000 audit (n = 7,436).

The average weight of trim per lesion (Table 1) resulting from the presence of injection-site lesions generally increased from 192.5 g in November 1995 to a peak in July 1997 of 435.8 g; mean trim loss has sporadically declined since July 1997 and was 249.8 g in July 2000. The increase in weight of injection-site lesion trim between November 1995 and July 2000 was not consistent with the findings of Dexter et al. (1994), who found that mean weight of trim loss per lesion declined from July 1991 to March 1993, but it was consistent with the findings of George et al. (1996), who found that mean lesion trim weight increased from July 1993 to July 1995. The spike in mean lesion excision weights in 1997 coincide with the report of George et al. (1996), demonstrating a toughening of muscle up to 7.62 cm away from the core of injection-site lesions and suggests that a short-term change in excision procedures for lesions may have been initiated by purveyors. Possible reasons for the recent increase in the weight of an injection-site lesion include changes in steak-cutting (hand cutting vs automation) and the changes in products (types of products, dosage of products, and adjuvant changes) (D. Griffin, University of Nebraska, personal communication).

Over the entire 15-audit period (November 1995 to July 2000), the incidence of lesions classified as "cystic" (encapsulated lesion containing fluid) and "woody callus" (older lesion that is characterized by infiltration with organized connective tissue and fat) did not change ($P > 0.05$; Table 2). The incidence of lesions classified

Table 1. Summary of injection-site damage (incidence and weight of lesions) in beef top sirloin butts for 15 audits

Audit period	Packer locations[a]	Steak cutter locations[b]	Number of subprimals evaluated	Incidence of lesions, %[c]	Average weight[d] of trim per lesion ± SE, g
November 1995	IA, IL, KS, NE, TX, UT	AR, CO, IL, TN, WA	19,814	11.40[e]	192.5[k] ± 3.1
March 1996	CO, IL, KS, NE, TX, UT	AR, CA, CO, IL, TN	19,935	10.29[f]	211.1[j] ± 3.7
July 1996	AZ, CO, KS, NE, TX, WI	AR, CA, IL, TN	19,197	8.51[g]	212.2[j] ± 3.7
November 1996	KS, NE, TX, UT	AR, CA, IL, TN	21,617	9.03[g]	231.2[i] ± 4.2
March 1997	CO, KS, NE, TX	AR, CA, IL, TN	19,065	7.48[h]	227.7[i] ± 4.6
July 1997	KS, NE	CA, IL, TN	11,088	5.61[i]	435.8[e] ± 12.9
November 1997	AZ, CO, IL, KS, NE, TX, UT, WI	CA, IL, TN, TX	14,644	5.59[i]	284.4[f] ± 7.2
March 1998	CO, KS, NE, UT	CA, IL, TX	12,927	4.75[j]	161.1[l] ± 6.1
July 1998	AZ, KS, NE, PA, TX	CA, TN, TX	8,693	6.07[i]	229.3[i] ± 6.2
November 1998	KS, NE, TX	CA, IL, TN, TX	8,044	4.43[j]	201.0[jk] ± 6.8
March 1999	CA, ID, KS, NE	CA, IL, TN, TX	16,237	4.64[j]	278.2[fg] ± 6.6
July 1999	KS, NE, TX	CA, IL, TN, TX	16,466	3.40[k]	210.7[jk] ± 4.7
November 1999	KS, NE, NY, TX	IL, TN, TX	10,772	2.67[l]	261.7[gh] ± 7.5
March 2000	KS, NE, TX	CA, IL, TN, TX	21,126	3.02[l]	229.4[i] ± 7.9
July 2000	CO, KS, NE, TX	CA, IL, TN, TX	20,455	2.06[m]	249.8[h] ± 9.3

[a]Packer-location origin of top sirloin butts.
[b]Steak-cutting facilities at which top sirloin butts were evaluated.
[c]Percentage of top sirloin butts that had an injection-site lesion.
[d]Average weight per lesion after excision.
[e,f,g,h,i,j,k,l,m]Values within a column lacking a common superscript letter differ ($P < 0.05$).

as "nodular" (lesion with nodules, the central foci of necrosis, surrounded by granulomatous inflammation) and "mineralized" (lesion containing mineralized remnants of muscle cells) decreased ($P < 0.05$), whereas the incidence of lesions classified as "clear" (older lesion that primarily contains clear connective tissue) increased ($P < 0.05$). Overall, 84% of the lesions examined between November 1995 and July 2000 were classified as "older" lesions (either woody callus or clear). Possible reasons for changes in lesion classification include a more critical selection of vaccine types, lower-dose vaccines, adjuvant changes, and the introduction of new products (D. Griffin, personal communication).

Mean lesion weights by type and audit period are presented in Table 3. The mass of tissue surrounding injection-site lesions that was excised by purveyors during portioning increased ($P < 0.05$) from November 1995 through July 2000 for clear and woody callus lesions

Table 2. Percentage incidence (of lesions excised) of injection-site lesions stratified by five types of lesion classification

	Lesion classification				
Audit period	Cystic[a]	Nodular[b]	Mineralized[c]	Clear[d]	Woody callus[e]
November 1995	0.75[ghi]	28.34[f]	0.13[gh]	46.06[kl]	24.71[l]
March 1996	0.59[ghi]	17.02[h]	0.00[h]	49.39[ik]	33.01[hi]
July 1996	0.31[i]	25.95[f]	0.00[h]	43.64[l]	30.11[ij]
November 1996	0.56[ghi]	25.87[f]	0.51[f]	45.44[kl]	27.61[jk]
March 1997	0.35[hi]	19.20[g]	0.49[f]	53.33[i]	26.63[kl]
July 1997	1.13[fg]	21.86[g]	0.48[fg]	49.84[ijk]	26.69[jkl]
November 1997	0.73[ghi]	16.85[h]	0.85[f]	45.79[kl]	35.78[gh]
March 1998	2.61[f]	12.87[hi]	0.65[f]	52.77[ij]	31.11[hij]
July 1998	0.57[ghi]	11.17[ij]	0.76[f]	49.62[ijk]	37.88[fg]
November 1998	1.40[fg]	14.89[hi]	0.84[f]	57.58[g]	25.28[kl]
March 1999	0.93[gh]	9.15[jk]	0.00[h]	49.34[jk]	40.58[fg]
July 1999	0.36[ghi]	7.14[kl]	0.00[h]	48.93[jk]	43.57[f]
November 1999	0.69[ghi]	4.51[lm]	0.00[h]	53.82[h]	40.97[fg]
March 2000	0.47[ghi]	5.64[lm]	0.31[fg]	54.08[g]	39.50[fg]
July 2000	0.24[i]	4.03[m]	0.00[h]	72.75[f]	22.99[l]

[a]Cystic = encapsulated lesion containing fluid.
[b]Nodular = lesion with nodules, the central foci of necrosis, surrounded by granulomatous inflammation.
[c]Mineralized = lesion that contains mineralized remnants of muscle cells.
[d]Clear = older lesion that contains primarily clear connective tissue.
[e]Woody callus = older lesion characterized by infiltration with organized connective tissue and fat.
[f,g,h,i,j,k,l,m]Percentages within a column lacking a common superscript letter differ ($P < 0.05$).

Table 3. Mean (± SE) weight (grams) per injection-site lesion stratified by five types of lesion classification

	Lesion classification				
Audit period	Cystic[a]	Nodular[b]	Mineralized[c]	Clear[d]	Woody callus[e]
November 1995	346.4^{fg} ± 55.6	146.4^{jk} ± 3.8	94.7^{hi} ± 25.0	116.2^{o} ± 3.7	223.7^{jk} ± 8.3
March 1996	358.7^{fg} ± 76.6	177.0^{j} ± 5.6	—	143.6^{mn} ± 3.2	216.8^{k} ± 9.5
July 1996	266.6^{g} ± 106.6	168.6^{jk} ± 5.5	—	147.7^{lmn} ± 4.4	221.8^{jk} ± 8.9
November 1996	291.2^{g} ± 77.5	189.6^{ij} ± 6.6	81.3^{i} ± 24.5	150.5^{klmn} ± 5.0	267.6^{hi} ± 10.3
March 1997	218.2^{g} ± 48.0	186.6^{ij} ± 8.0	188.4^{ghi} ± 27.3	159.3^{jklm} ± 4.6	240.9^{ij} ± 13.1
July 1997	291.9^{g} ± 65.8	470.5^{f} ± 28.6	311.3^{fgh} ± 105.8	299.1^{f} ± 15.8	525.0^{f} ± 26.1
November 1997	310.5^{fg} ± 84.2	216.6^{hi} ± 15.2	356.9^{ab} ± 91.8	240.4^{g} ± 11.1	277.8^{gh} ± 11.9
March 1998	293.6^{g} ± 83.3	94.2^{k} ± 13.9	352.8^{fg} ± 90.3	108.4^{o} ± 6.8	149.0^{l} ± 12.1
July 1998	256.7^{g} ± 91.6	180.1^{ij} ± 16.6	316.8^{fgh} ± 82.8	175.3^{hij} ± 7.3	224.1^{jk} ± 12.1
November 1998	439.0^{f} ± 166.8	158.2^{jk} ± 14.7	482.3^{f} ± 246.3	127.2^{no} ± 6.1	206.7^{k} ± 14.7
March 1999	482.4^{f} ± 245.9	235.1^{gh} ± 18.6	—	197.7^{h} ± 6.8	303.0^{g} ± 11.3
July 1999	194.0^{g} ± 52.0	169.8^{jk} ± 16.4	—	151.2^{jklmn} ± 5.5	213.9^{k} ± 7.8
November 1999	512.0^{f} ± 318.7	208.5^{hij} ± 23.0	—	196.2^{hi} ± 7.5	267.8^{hi} ± 13.0
March 2000	374.4^{fg} ± 92.0	298.1^{g} ± 30.9	132.0^{ghi} ± 18.0	168.6^{ijkl} ± 10.4	215.1^{k} ± 12.8
July 2000	93.0^{g} ± 0.0	173.1^{jk} ± 30.2	—	171.4^{hijk} ± 8.3	296.7^{gh} ± 28.1

[a]Cystic = encapsulated lesion containing fluid.
[b]Nodular = lesion with nodules, the central foci of necrosis, surrounded by granulomatous inflammation.
[c]Mineralized = lesion containing mineralized remnants of muscle cells.
[d]Clear = older lesion that contains primarily clear connective tissue.
[e]Woody callus = older lesion characterized by infiltration with organized connective tissue and fat.
[f,g,h,i,j,k,l,m,n,o]Means within a column lacking a common superscript letter differ ($P < 0.05$).

but not for other classes of lesions. Mean weights of cystic, nodular, and mineralized lesions did not increase when comparing audits of November 1995 vs July 2000, but excised weights of nodular lesions increased ($P < 0.05$) to a peak value of 470.5 g in July 1997 and weights of excised mineralized lesions increased ($P < 0.05$) to a peak value of 482.3 g in November 1998.

Summary

Reductions in lesion incidence in top sirloin butts from U.S. fed steer and heifers for the period of November 1995 through July 2000 (from 11.4% to 2.1%, respectively) generated an approximate net savings of $2.15 per steer or heifer slaughtered. This equates to an industrywide savings of $76,078,100, based on the projected 30.31 million steers and heifers to be harvested in 2000 (USDA, 2000).

Implications

Injection-site lesions have caused enormous economic loss to the U.S. beef industry and have been a serious quality assurance problem. Continual reductions in injection-site lesions will improve the profitability of beef production.

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